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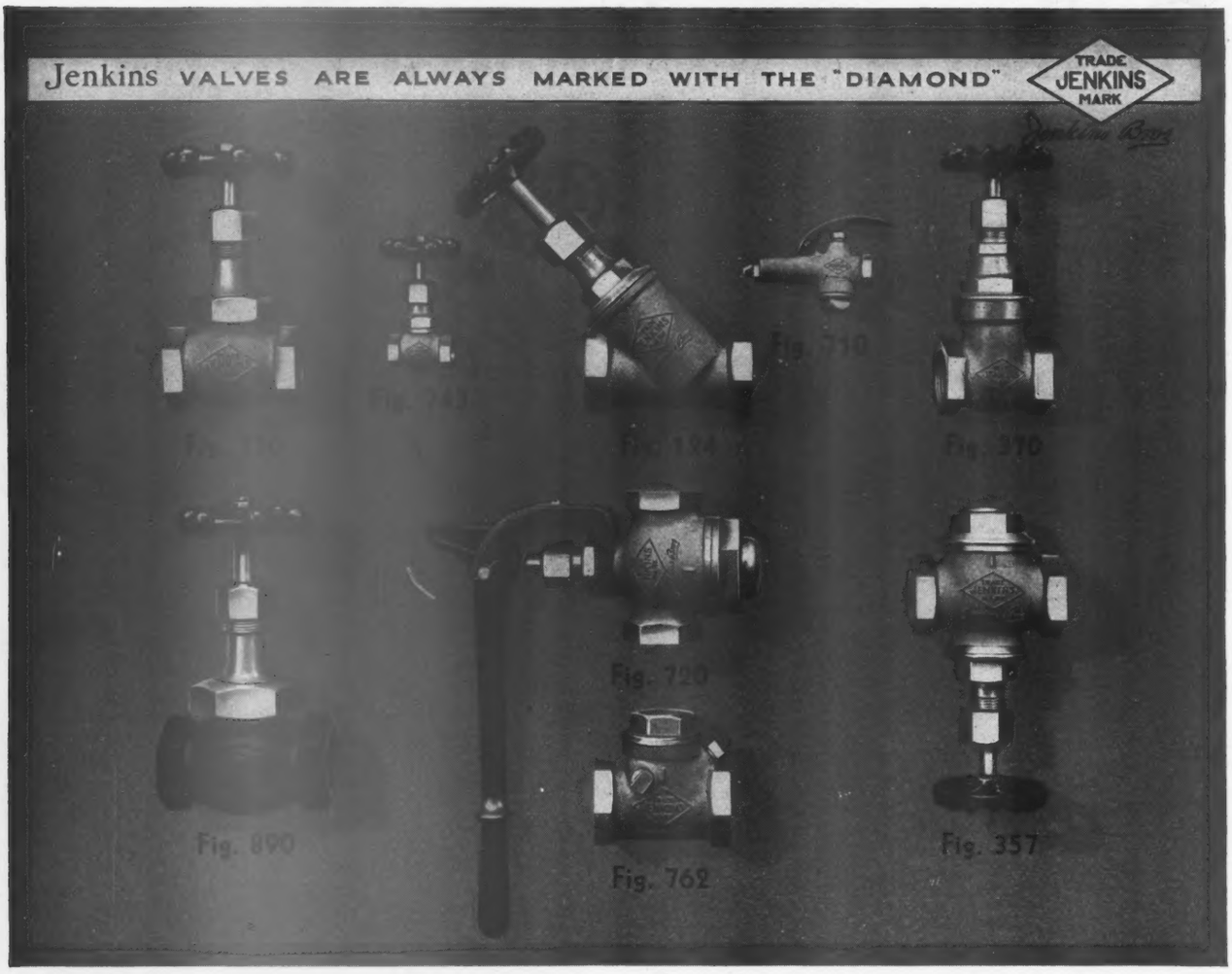

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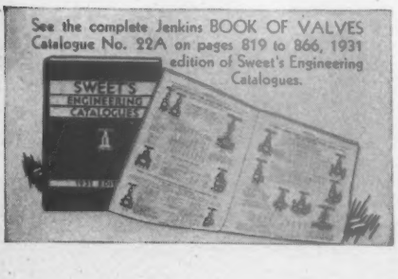
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Railway
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Founded in 1832 as the American Rail-Road Journal

January - 1932

Mechanical-Department 1931 Expenditures Lowest on Record

Review of last year's business shows only 237 locomotives, 22 passenger cars, and 14,687 freight cars ordered by the railroads in the United States and Canada—Few orders placed for machine tools and shop equipment

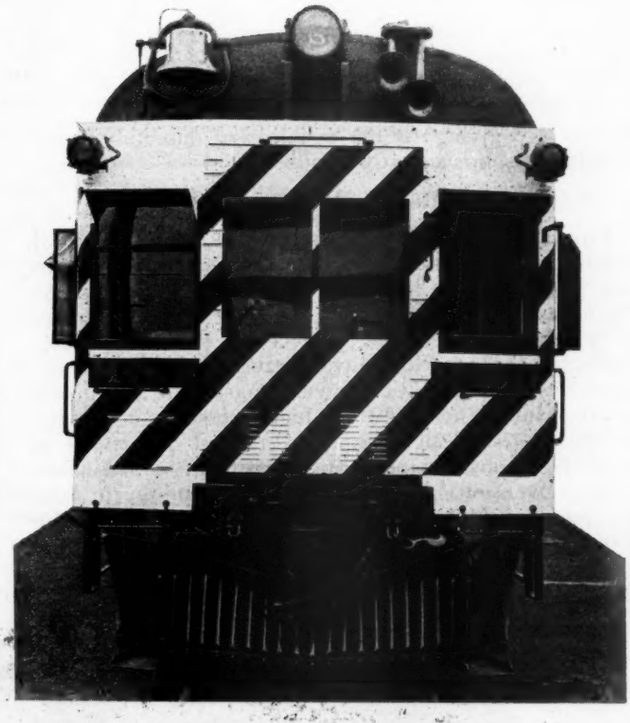
THE year 1931 will be written down in the records as one of the worst in railroad history. During the year just ended the purchases by the Class I railroads from manufacturers amounted to about $639,000,000. Under normal conditions the annual purchases from manufacturers by the Class I roads amounts to approximately $1,350,000,000. The amount of money spent by the railroads last year for manufactured materials, supplies and equipment was about 53 per cent less than the normal amount. Furthermore, the total earnings of the Class I roads were approximately $4,246,500,000, or about $1,100,000,000 less than in 1930 and about $2,100,000,000 less than in 1929. The total earnings for 1931 were the smallest since 1917.

This large decrease in earnings necessarily forced most drastic reductions in maintenance. Expenditures for maintenance of equipment were about $202,000,000 less than in 1930, and about $388,000,000 less than in 1929.

Orders Placed in 1931 Compare Only with 1919 and 1921

The number of locomotives ordered for domestic service during 1931 was only 235; freight cars, 10,880, and passenger cars, 11. The smallest orders ever reported before, as shown in the charts, were those placed in 1919, under government operation, and again in 1921 as the result of the depression that came at the end of 1920.

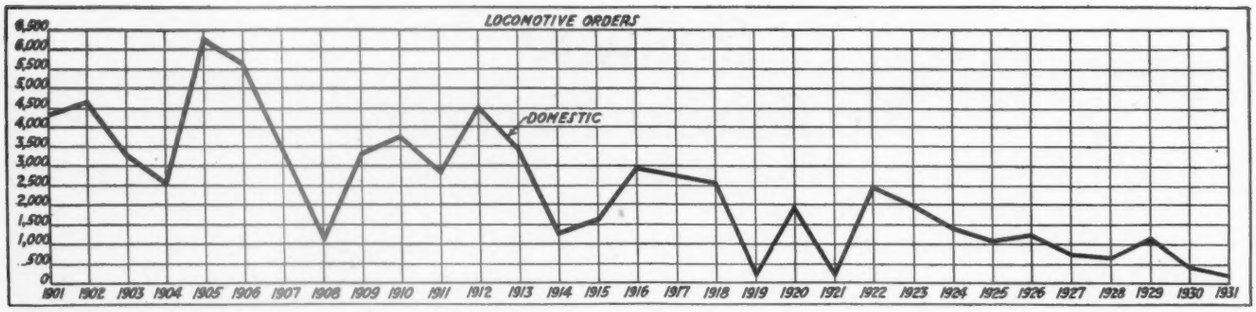
With respect to equipment orders in Canada, only two locomotives and 11 passenger cars were ordered. On the other hand, orders for freight cars placed by Canadian railroads with builders in that country totaled 3,807, or nearly double the 1930 figure of 1,936.



Sante Fe gas-electric car equipped with a Brill 535-hp. power plant—General Electric transmission

Orders for rail-motor cars were also the smallest since 1922, the first year for which records of motor-car orders were compiled. Twenty-six motor cars were ordered for domestic service and four for service in Canada. No trailer cars were ordered.

Orders placed during 1931 for machine tools and shop equipment were also small, as was to be expected. Purchases of gas and electric trucks, trailers and hand-lift trucks dominated the year's business. These pur-



Locomotive orders from 1901 to 1931

chases and orders placed for nearly 10,000 skids of a variety of box and platform construction are an indication of the attention which mechanical-department officers are giving to the problem of handling materials in the shops and store houses.

Orders for Locomotives Since 1918

Year	Domestic	Canadian	Export	Total
1918	2,593	209	2,086	4,888
1919	214	58	898	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,600	68	131	2,799
1923	1,944	82	116	2,142
1924	1,413	71	142	1,626
1925	1,055	10	209	1,274
1926	1,301	61	180	1,542
1927	734	58	54	846
1928	603	98	27	728
1929	1,212	77	106	1,395
1930	440	95	20	555
1931	235	2	28	265

Progress Made in Locomotive Design

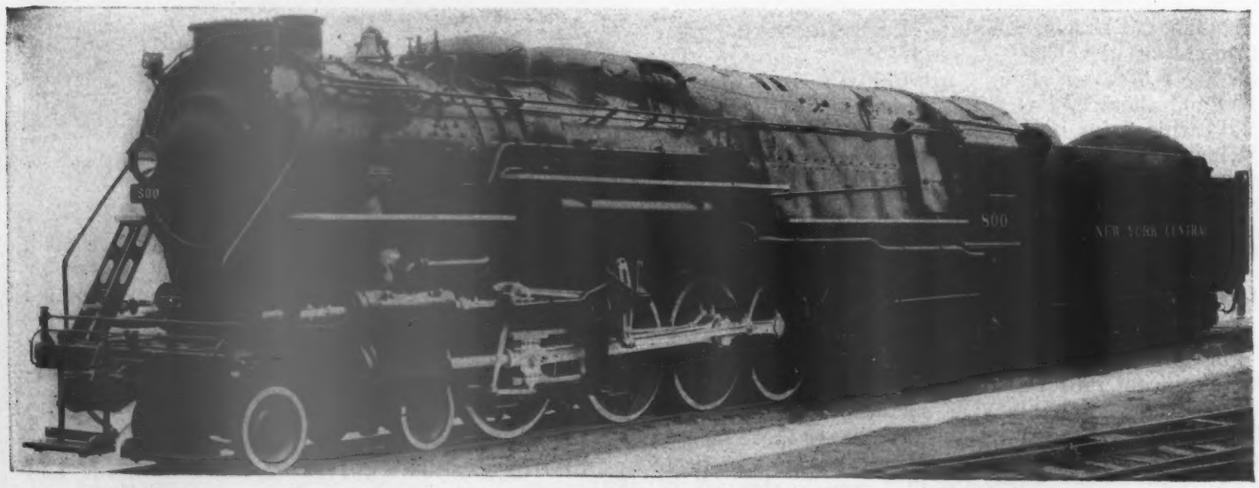
Two noteworthy events are in the record of 1931 locomotive progress. These are the completion of the two multi-pressure locomotives, one for the Canadian Pacific and one for the New York Central, the design of which was the joint project of the Superheater Company, the American Locomotive Company, and the respective railroads. This event marks the distinctive entrance into a field of truly high pressures in American locomotive design, requiring radical departures in proportions, arrangement and details of construction from conventional practices. The second event was the recent completion by the American Locomotive Company of two Hudson type locomotives for the New York Central which, with the exception of the trailer axles, have complete installations of roller bearings on all axle journals. These two locomotives both have SKF engine trucks. One has SKF bearings and the other Timken bearings on the driving-axle and tender-axle journals.

Last year was one of comparative prosperity in so far as orders for electric locomotives were concerned. The Pennsylvania orders for a total of 150 of these for use in connection with its extensive electrification program brought the total electrics ordered in any one year above the number of steam locomotives purchased for the first time.

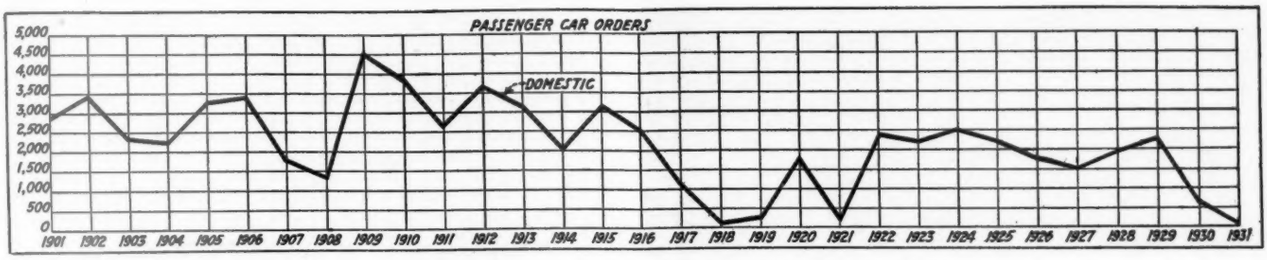
The outstanding locomotive orders during the year were eight 4-6-4 types of 45,822-lb. tractive force ordered by the Chicago, Milwaukee, St. Paul & Pacific; ten 4-8-4 type ordered by the Delaware, Lackawanna & Western; 20 4-8-4 type having a tractive force of approximately 85,000 lb. ordered by the Lehigh Valley, and six single-expansion articulated 2-8-8-2 type loco-

Orders for Passenger Cars Since 1918

Year	Domestic	Canadian	Export	Total
1918	9	22	26	57
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,488
1923	2,214	263	6	2,483
1924	2,554	100	25	2,679
1925	2,191	50	76	2,317
1926	1,868	236	58	2,162
1927	1,612	143	48	1,803
1928	1,930	334	29	2,293
1929	2,303	122	33	2,458
1930	667	203	15	885
1931	11	11	21	43



Multipressure 4-8-4 type locomotive built for the New York Central by the American Locomotive Company, with the co-operation of the Superheater Company



Passenger car orders from 1901 to 1931

motives ordered by the Western Pacific. The largest orders placed for oil-electric locomotives were for seven placed by the Bush Terminal and five by the Lehigh Valley.

Eleven Passenger Cars Ordered in 1931

Reflecting the influence of the business depression, orders placed in the United States for passenger-train cars in 1931 numbered only 11. The unusually low total of 11 cars ordered not only ranks as the poorest year since 1918, when only nine were purchased, but also as the second poorest since 1901.

The sudden slump in passenger-train car buying, moreover, affected all classes of passenger-train equipment—coaches, Pullman cars, and mail, baggage and express cars.

Like those placed by the railroads of the United States, passenger-train car orders in Canada in 1931 also totaled 11, six of the cars being purchased by the Canadian Pacific and five by the Canadian National.

Production reports show that the total number of passenger-train cars built in the United States and Canada during 1931 was 285, against 1,514 built last year. Of the 1931 total, 198 cars were built in the United States for export and 66 in Canada for Canadian use. Production for domestic use in this country was the lowest on record; production for export was the lowest since 1929, and production in Canada was the lowest reported since 1925.

New Developments in Construction

The decline in all types of passenger-train traffic experienced during 1931 is due in all probability largely to the depression and is only in smaller degree a continuance of the downward trend of the past decade. Should this be so, at least a slight upturn in passenger revenues may be expected to follow any revival in general business, while it is equally fair to assume that any such revival would stimulate the buying of passenger equipment. New developments in passenger-car design and construction, and particularly the perfection of various methods of air-conditioning, have tended to increase passenger comfort and thus, under normal business conditions, should aid the roads to hold or to increase their passenger traffic, with a consequent stimulus to passenger car buying.

From a development, such as air conditioning, once inaugurated, there is no turning back. The extent to which it has demonstrated its ability to remove two of the principle discomforts of railway travel—heat and

Orders for Rail-Motor Cars and Trailers

	1923	1924	1925	1926	1927	1928	1929	1930	1931
For service in U. S.	77	120	149	142	180	175	132	54	26
For service in Canada	3	12	7	4	9	10	10	8	4
For export	22	..	34	32	12	9	28	3	10
Total	102	132	190	178	201	194	169	65	40
Motor cars	93	112	171	161	176	172	159	56	40
Trailers	9	20	19	17	25	22	11	9	..

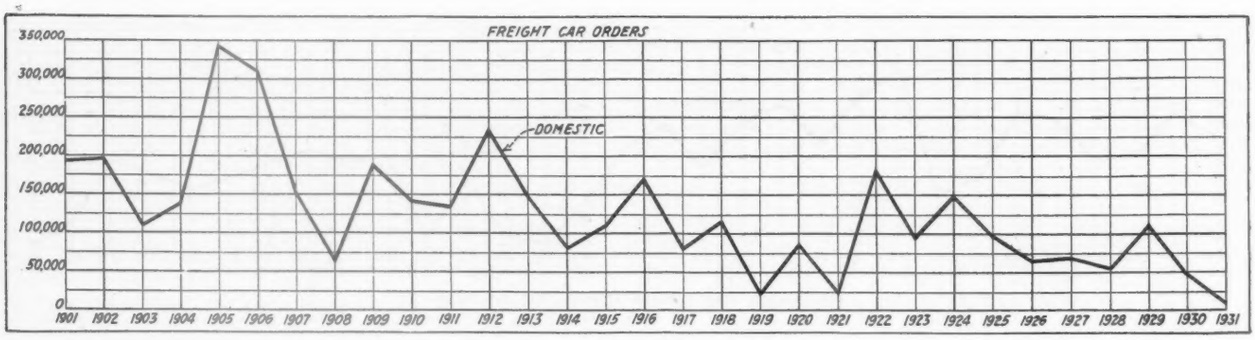
Comparison of Rail-Motor Weights, U. S. and Canada

Weights	1926	1927	1928	1929	1930	1931
25,000 lb. and under	7	..	3	3	..	..
Over 25,000 lb. to and including 50,000 lb.	7	..	4	6	..	..
Over 50,000 lb. to and including 75,000 lb.	2	4	4	..	2	..
Over 75,000 lb. to and including 100,000 lb.	79	29	16	5	..	..
Over 100,000 lb. to and including 125,000 lb.	32	88	62	20	2	..
Over 125,000 lb. to and including 150,000 lb.	5	21	58	54	29	25
Over 150,000 lb. to and including 175,000 lb.	..	..	11	24	13	4
Over 175,000 lb.	1	..	..	7	..	1
Unclassified	..	26	5	13	7	..

Power-Plant Capacity of Rail-Motor Cars, U. S. and Canada

Horsepower	1926	1927	1928	1929	1930	1931
100 or less	14	2	5	6	2	..
Over 100 to and including 125	7	..	1	3	..	..
Over 125 to and including 150	..	..	4	1	..	..
Over 150 to and including 175	1	..	1	..	..	..
Over 175 to and including 200	3	3	1	..	..	..
Over 200 to and including 250	65	43	13	2	..	..
Over 250 to and including 300	26	76	64	15	7	1
Over 300 to and including 350	..	..	30	2	2	..
Over 350 to and including 400	..	..	18	64	25	22
Over 400 to and including 450	8	7	6	2	..	1
Over 450 to and including 500	11	1	4	5	..	..
Over 500	..	8	15	30	17	6
Unclassified	..	24	1	2	..	..

All-welded hopper built for the Chicago Great Western by Pullman Car & Manufacturing Corporation



Freight car orders from 1901 to 1931

dust—has already created a widespread desire for it on the part of the traveling public.

Rail-Motor Cars Ordered

As shown in the table of orders for rail-motor cars and trailers, the number of cars ordered in 1931 is the lowest recorded. Of the 30 cars ordered, 22 have

Orders for Freight Cars Since 1918

Year	Domestic	Canadian	Export	Total
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9,056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	103,552
1924	143,728	1,867	4,017	149,612
1925	92,816	642	2,138	95,596
1926	67,029	1,495	1,971	70,495
1927	72,006	2,133	646	74,785
1928	51,200	8,901	2,530	62,631
1929	111,218	9,899	3,023	124,140
1930	46,360	1,936	1,200	49,496
1931	10,880	3,807	151	14,838

power plants of 400-hp. capacity and one has a plant of 300 hp. One car has a 415-hp. capacity power plant.

Of the six rail-motor cars having power-plant capacities of 500 hp. and over, the 900-hp. car ordered by the Atchison, Topeka & Santa Fe from the Pullman Car & Manufacturing Corporation is the most notable. This is to be an articulated unit with Electro-Motive engines and General Electric transmission. Its estimated weight is 240,900 lb. The Santa Fe was the largest purchaser of rail-motor cars during the year, ordering a total of 16 units. Three of these are 550-hp. capacity cars, weighing 136,450 lb. each, which were built by the J. G. Brill Company. The remaining 12 cars ordered by the Santa Fe are of 400-hp. capacity.

Although the 1931 orders for rail-motor cars are small, the figures in the table showing the power-plant capacities indicate a continuance of the trend toward higher capacity units.

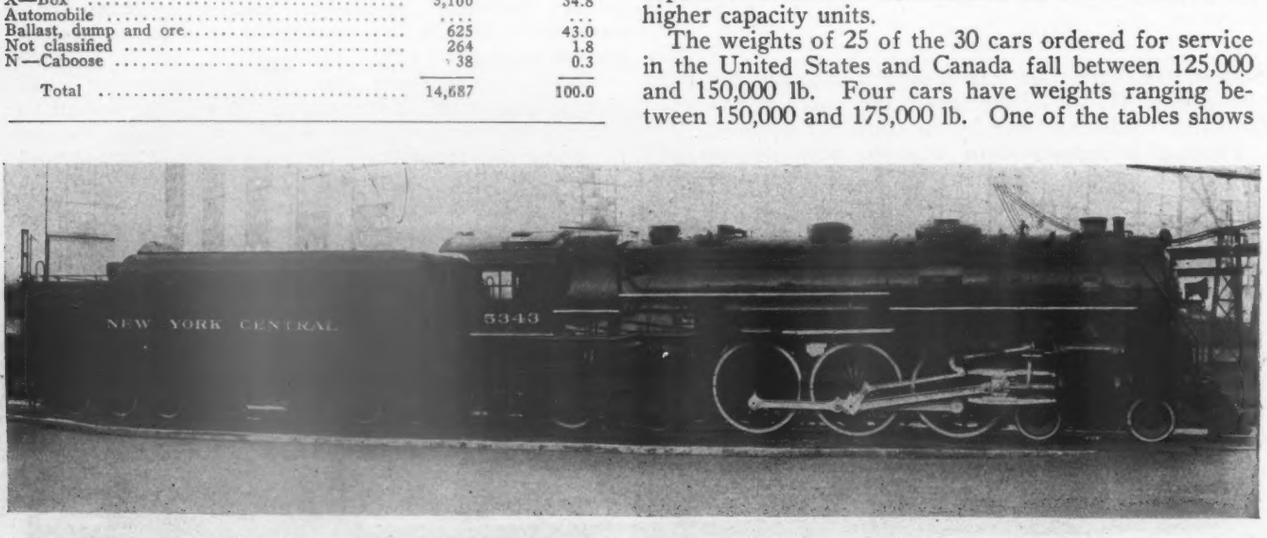
Types of Freight Cars Ordered in 1931 for Use in the United States and Canada

Type	Number	Per Cent
F—Flat and logging	420	2.8
G—Gondolas	1,562	10.7
H—Hopper	3,238	22.0
R—Refrigerator	2,323	15.8
S—Stock and poultry	760	5.2
T—Tank	357	2.3
X—Box	5,100	34.8
Automobile	....	....
Ballast, dump and ore	625	43.0
Not classified	264	1.8
N—Caboose	38	0.3
Total	14,687	100.0

Freight Cars Built Each Year Since 1913

	United States			Canadian			
Year	Domestic	Foreign	Total	Domestic	Foreign	Total	Grand total
1913	176,049	9,618	185,667	22,017	....	22,017	207,684
1914	97,626	462	98,088	6,453	....	6,453	104,451
1915	58,226	11,916	70,142	1,758	2,212	3,970	74,112
1916	111,516	17,905	129,421	....	....	5,580	135,001
1917	115,705	23,938	139,643	3,658	8,100	11,758	151,401
1918	67,063	40,981	108,044	14,704	1,960	16,664	124,708
1919	94,981	61,783	156,764	6,391	30	6,421	163,185
1920	60,955	14,480	75,435	....	....	....	....
1921	40,292	6,412	46,704	8,404	745	9,149	55,853
1922	66,289	1,126	67,415	458	100	558	67,973
1923	175,748	2,418	178,166	....	....	....	....
1924	113,761	1,141	114,902	1,721	....	1,721	116,623
1925	105,935	3,010	108,945	....	....	....	....
1926	88,862	2,771	91,633	1,645	....	1,645	93,278
1927	63,390	1,087	64,477	2,851	....	2,851	67,328
1928	46,060	938	46,998	5,158	....	5,158	52,156
1929	82,240	3,168	85,408	8,557	....	8,557	93,965
1930	75,188	1,909	77,097	6,923	....	6,923	84,020
1931	13,205	409	13,614	4,633	....	4,633	18,247

The weights of 25 of the 30 cars ordered for service in the United States and Canada fall between 125,000 and 150,000 lb. Four cars have weights ranging between 150,000 and 175,000 lb. One of the tables shows



The engine-truck, driving-wheel and tender-truck journals have SKF roller bearings—No. 5344 has Timken bearings on driving and tender-truck journals—Built by American

the distribution of the motor cars by weight since 1926.

All of the cars ordered during 1931 for service by the steam railroads on this continent have gas-electric power plants. No oil-electric units were ordered.

Domestic Total of 10,880 Freight Cars Sets New Low Record

A total of 10,880 freight cars were ordered for domestic service in the United States. This is less than one-quarter the number ordered in 1930, and is only one-tenth of the 1929 business which involved the purchase of 111,218 cars. Furthermore, it represents just about half the business done in 1919 when the previous low point was reached with orders for 22,062 cars.

A somewhat brighter picture is gleaned from the statistics of freight car orders placed by Canadian railways with builders in that country. The 1931 total of these latter was 3,807, or nearly double the 1930 figure of 1,936. In 1929 Canadian roads ordered 9,899 freight cars and in 1928 they purchased 8,901. Despite the unfavorable comparison with these two years, however, the 1931 total is larger than that of any of the five other years since 1923. It has, in fact, been exceeded in only six of the past 14 years.

The explanation of the poor business accruing to car builders during 1931 is to be found in the statistics of railway traffic. Car loadings which averaged over a million a week in 1929 did not cross the 800,000 mark for any week of 1931. With such a traffic decline the freight car surplus reached proportions approaching each week the total of cars loaded. During the first half of the year the surplus averaged more than 600,000 cars, while it was consistently above the half-million mark for the remaining six months. During the last week of November, for example, 558,807 cars of revenue freight were loaded while the freight car surplus was reported as 659,346 cars.

The events of the past year mark the beginning of a new era in the development of rolling stock for freight transportation. The action of the Interstate Commerce Commission in permitting departures from the conventional tariff structure, to aid the railroads in their efforts to meet the competition of motor trucks on the highways, has opened an entirely new field for the exercise of initiative and ingenuity by railway managements in providing new forms of transportation service which will undoubtedly grow steadily in importance. These forms of service require the use of demountable containers, several types of which are developed.

During the year the Bessemer & Lake Erie ordered 1,050 hopper cars of 180,000 lb. capacity; the Northern Pacific, 1,500 box and 500 stock cars, and the Canadian National, 2,800 box cars, 500 drop-end gondolas and 500 general service cars. These were the largest freight-car orders placed during 1931. The L.C.L. Corporation ordered 275 container cars, a design of car developed especially for container lading.

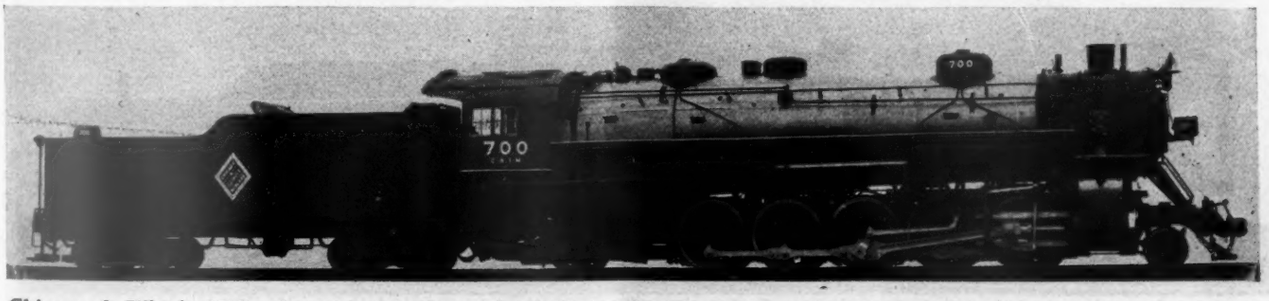
Passenger Cars Built Each Year Since 1913

Year	United States Domestic	United States Foreign	United States Total	Canadian Domestic	Canadian Foreign	Canadian Total	Grand total
1913.....	2,559	220	2,779	517	....	517	3,296
1914.....	3,310	56	3,366	325	....	325	3,691
1915.....	1,852	14	1,866	83	....	83	1,949
1916.....	1,732	70	1,802	37	....	37	1,839
1917.....	1,924	31	1,955	45	....	45	2,000
1918.....	1,480	92	1,572	1	....	1	1,503
1919.....	306	85	391	160	....	160	551
1920.....	1,272	168	1,440	....	....	....	....
1921.....	1,275	39	1,314	361	....	361	1,675
1922.....	676	144	820	71	....	71	891
1923.....	1,507	29	1,536	....	....	....	....
1924.....	2,150	63	2,213	167	....	167	2,380
1925.....	2,363	50	2,413	....	....	....	....
1926.....	2,184	102	2,286	285	....	285	2,571
1927.....	1,785	50	1,835	126	....	126	1,961
1928.....	1,356	15	1,371	237	....	237	1,608
1929.....	1,254	20	1,274	162	....	162	1,436
1930.....	1,264	40	1,304	210	....	210	1,514
1931.....	198	21	219	66	....	66	285

Interior of Pullman's latest air-conditioned car

Machine Tools and Shop Equipment

One hundred and one roads—about 96 per cent of the total route mileage—reported their purchases of machine tools and shop equipment made last year. Of the



Chicago & Illinois Midland 2-10-2 type locomotive built by the Lima Locomotive Works, Inc.—Tractive force, 77,700 lb.—Equipped with Franklin booster with tractive force of 10,500 lb.

101 reporting roads, 54 reported purchases of one or more units. Forty-six made no purchases during the year.

Seventeen roads, representing nearly 22 per cent of the total route mileage, placed orders for 10 or more units during the year. The larger part of these orders was for material-handling equipment. A total of 18 railroads placed orders for power trucks and trailers. Fifty-three power trucks were ordered, of which the large majority were of the elevating-lift type or were equipped with cranes. Of the total number ordered, 26 were electric and 27 gasoline-engine driven. The number of trailers ordered last year, a total of 234, is the largest number ordered any year since 1924, with the exception of 1928 and 1930 when 395 and 785 were ordered, respectively.

Although the orders in 1931 for machine tools did not amount to much, still the comparative distribution of units, as shown in the vertical columns of the table under each year, bear a striking proportional similarity. Of the 56 items listed in the table, only four show blank spaces for 1931. Orders for grinding machines dominate the tool groups with a total of 77, of which 54 are floor grinders. Of the heavier types of machine tools, engine lathes, vertical drill presses, vertical boring mills and horizontal milling machines predominate. Orders for miscellaneous forging machines compare favorably with previous years, except 1929, 1926 and 1924.

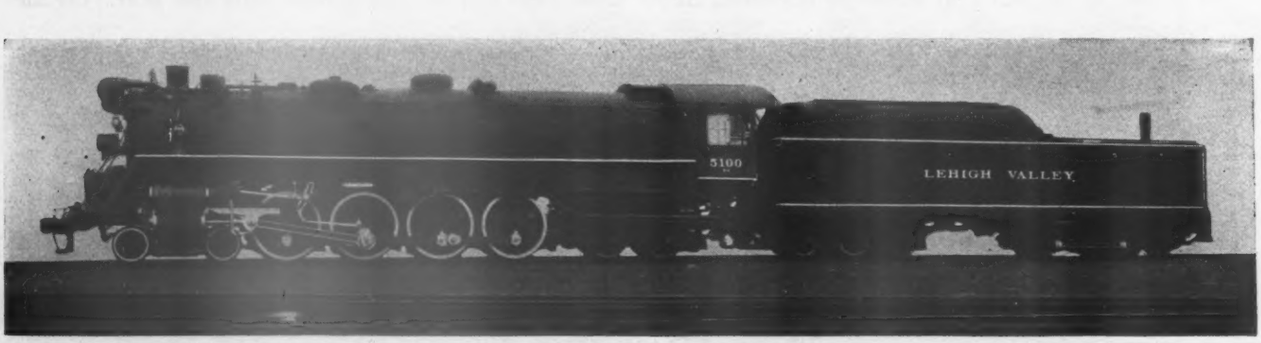
Much of the purchasing done by the railroads during the year was for shop-equipment units not listed in the table. A considerable number of spray-painting equipments; water pumps, the most of which were for boiler washing; units for electrical shops, shop power, etc.; jacks of large capacity for car and locomotive repair work; locomotive drafting units, and locomotive pullers were ordered last year. In addition, a number of units were ordered for installation in oil and waste renovating plants. Several railroads installed hot-water boiler washing plants. Some of the shop-equipment units ordered were for the precooling of passenger cars.

All things considered, the mechanical departments of the railroads are deserving of much credit for what they have accomplished during the past year. That equipment conditions were no worse in the face of the extremely drastic curtailments of expenditures for maintenance is real evidence of the high standards of maintenance which had been in effect for a number of years prior to the advent of the general depression. However, when the demand for railroad transportation increases, there will be few locomotives and cars now in storage in condition for immediate service. The limited volume in which materials and appliances needed to maintain rolling stock have been purchased during the past year has made it necessary to "rob" equipment on the storage tracks.

The past few years have seen radical changes in the methods and practice of maintaining locomotives and rolling stock. There is every reason to believe that once railroad earnings become what they ought to be that there will be many railroads in the market for modern tools and shop equipment.

Machine Tools and Shop Equipment Purchased Over an Eight-Year Period

	1931	1930	1929	1928	1927	1926	1925	1924
Lathes								
Axle	2	25	36	28	27	72	47	35
Engine	13	84	134	115	149	236	178	209
Turret	4	24	48	38	33	55	51	93
Wheel	6	24	25	11	14	32	34	26
Drill Presses								
Radial	5	31	42	31	48	93	65	71
Vertical and others	17	35	121	63	92	203	114	107
Planers	1	13	49	12	23	39	25	40
Shapers	7	20	53	42	46	75	70	74
Slotters	4	2	11	6	8	7	9	13
Boring Mills								
Horizontal	1	4	7	8	4	13	13	16
Vertical and others	5	31	53	46	49	93	56	64
Milling Machines								
Universal	1	2	4	5	8	26	15	18
Horizontal and others	8	16	53	24	19	37	23	32
Grinding machines								
Cylindrical	9	2	8	13	10	20	9	13
Internal	8	8	13	27	32	20	36	20
Surface	6	1	27	10	10	22	14	17
Double end, tool and others	54	182	258	224	236	346	232	190
Metal-cutting saws	7	28	35	29	31	68	40	36
Portable boring, facing and turning machines	21	29	30	34	29	80	58	51
Bolt threaders and cutters	9	13	43	27	30	54	53	54
Pipe threaders and cutters	10	22	50	35	45	66	40	42
Presses								
Wheel	3	20	13	4	17	24	22	20
Others	5	30	33	50	42	74	60	58
Hammers								
Steam	3	7	8	18	12	37	34	19
Other power	3	13	15	21	18	24	10	12
Forging machines								
Bulldozers	..	4	5	2	9	5	6	11
Others	8	3	20	3	5	20	6	12
Punches	1	3	10	10	4	30	15	13
Shears	11	18	36	42	23	72	31	41
Combination punch and shear	1	8	16	16	20	39	33	22
Flue Shop Machinery								
Flue welders	1	5	7	9	12	16	7	22
Miscellaneous	..	4	20	14	24	11	19	32
Boiler Shop Machinery								
Flangers	3	1	6	9	4	17	21	17
Forming rolls	..	3	12	9	9	14	9	12
Riveters	27	12	37	7	5	15	8	..
Blowers	10	37	40	53	37	100	97	..
Furnaces								
Oil	8	32	52	64	53	68	63	..
Electric and others	8	27	118	43	27	18	96	..
Woodworking Machinery								
Boring machines	1	4	15	11	12	9	8	10
Mortisers	..	5	15	9	11	21	16	13
Surfacers and jointers	3	23	16	18	15	43	17	17
Tenoners	1	4	13	7	5	11	11	12
Wood cutting saws	14	19	31	33	57	93	64	62
Others	12	25	40	32	24	39	44	32
Overhead cranes	10	17	81	39	32	50	23	..
Car and loco. hoists and drop tables	9	40	65	60	63	24	14	..
Hoists								
Air	21	84	66	75	53	116	101	..
Electric	18	82	177	44	56	54	51	..
Chain	18	34	30	42	85	41	78	..
Trucks								
Electric	26	71	64	90	55	98	114	..
Gas	27	66	126	65	33	76	17	..
Trailers	234	785	157	395	132	135	85	..
Air-Brake test racks	2	11	10	30	43	28	24	..
Air compressors	25	39	66	52	64	82	54	..
Motors	56	115	124	101	122	138	27	..
Electric welders	29	69	96	72	46	158	110	..



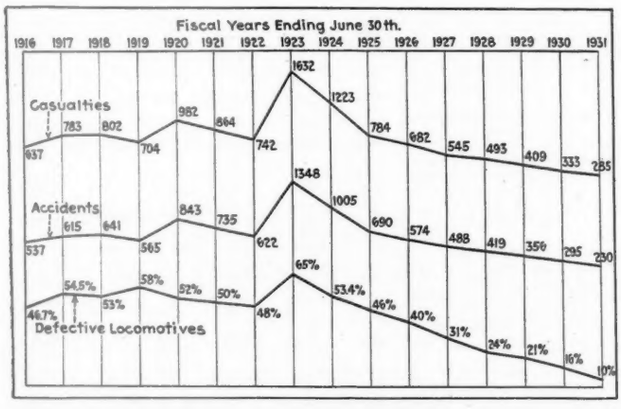
Lehigh Valley 4-8-4 type locomotive built in March, 1931, by the Baldwin Locomotive Works—Tractive force 66,400 lb.

Annual Report of Bureau of Locomotive Inspection

Twentieth annual report of the Bureau of Locomotive Inspection to the Interstate Commerce Commission shows best record since 1916—Boiler explosions continue to be most prolific source of accidents

A. G. PACK, chief inspector, Bureau of Locomotive Inspection, in his report to the Interstate Commerce Commission, states that during the fiscal year ended June 30, 1931, there were fewer locomotive accidents than at any time during the past 20 years and that this reduction has been consistently made in about the same ratio as the condition of locomotives has been improved. As in former years, boiler explosions continue to be the most prolific source of accidents. During the fiscal year ended June 30, 1931, boiler explosions caused 15 fatalities and 41 injuries. Only 16 fatal accidents resulted from failures of steam locomotives and tenders and their appurtenances, the one death, not accounted for from boiler explosions, being caused by a defective coupler.

The fact that the railroads were able to continue to



Relation of defective locomotives to accidents and casualties resulting from locomotive failures

improve their record with respect to defective locomotives, handicapped as they have been by curtailed expenditures for maintenance, speaks well for the effective work being done by the mechanical departments in meeting the emergencies created by the depression

Condition of Locomotives, Found by Inspection, in Relation to Accidents and Casualties

Fiscal year ended June 30	Per cent of locomotives inspected found defective	Number of locomotives ordered out of service	Number of accidents	Number of persons killed	Number of persons injured
1923	65	7,075	1,348	72	1,560
1924	53	5,764	1,005	66	1,157
1925	46	3,637	690	20	764
1926	40	3,281	574	22	660
1927	31	2,539	488	28	517
1928	24	1,725	419	30	463
1929	21	1,490	356	19	390
1930	16	1,200	295	13	320
1931	10	688	230	16	269

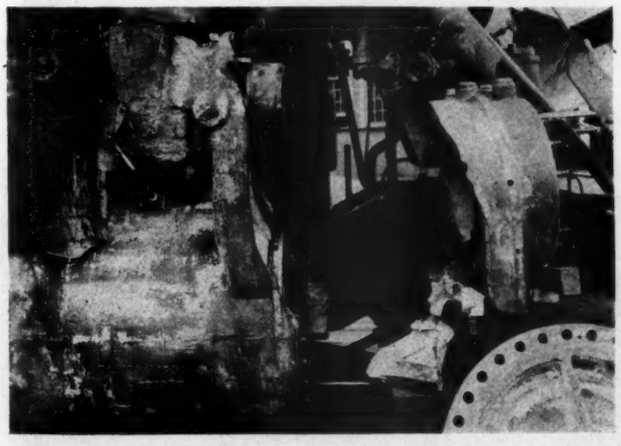
and also for the standards of maintenance established in past years. Following is an abstract of Mr. Pack's report:

Investigation of Accidents and Condition of Locomotives

During the year 10 per cent of the steam locomotives inspected by our inspectors were found with defects or errors in inspection that should have been corrected before being put into use as compared with 16 per cent for the previous year. This reflects the best condition of locomotives in service ever recorded. A summary of all accidents and casualties to persons occurring in connection with steam locomotives compared with the previous year shows a decrease of 22 per cent in the number of accidents, an increase of 23 per cent in the number of persons killed, and a decrease of 15.9 per cent in the number of persons injured. The increase in the number of persons killed was due to one particularly violent boiler explosion in which six persons were killed. This explosion was due to lapse of ordinary caution on the part of the enginehouse force rather than to any structural defect in the boiler.

The decrease in accidents and casualties brought about by the decrease in defective locomotives, and the converse, are graphically shown by chart. The percentage of locomotives inspected found defective; number ordered out of service; number of accidents resulting from the failure of some part or appurtenance of the locomotive or tender, including the boiler; number of persons killed; number of persons injured, are shown in a table for the fiscal years ended June 30, 1923, to 1931.

It will be noted from the table that from 1923 to 1931, both inclusive, the percentage of locomotives inspected found defective consistently decreased from 65 to 10; the number of locomotives ordered out of service de-



Broken cylinder casting caused by compression when the valve centered due to loss of the link-block pin

creased in the same manner from 7,075 to 688, or 90.3 per cent; the number of accidents decreased from 1,348 to 230, or 82.9 per cent; the number of persons killed decreased from 72 to 16, or 77.8 per cent; the number of persons injured decreased from 1,560 to 269, or 82.8 per cent.

It may be noted from the chart that there were fewer locomotive accidents during the year than at any time during the past 20 years, and that this reduction has been consistently made in about the same ratio as has the condition of locomotives been improved. If proper inspections and repairs are made in accordance with the requirements of the law and rules, many accidents will be avoided. Some of the carriers are maintaining their locomotives in such condition as to fully meet all the requirements of the law and the rules, regulations, and instructions made or given thereunder while other carriers were found to be delinquent in various degrees.

Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered From Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30					
	1931	1930	1929	1928	1927	1926
1. Air compressors	481	873	1,202	1,282	1,679	2,151
2. Arch tubes	60	87	104	103	127	204
3. Ash pans and mechanism	81	76	132	133	192	211
4. Axles	10	12	20	7	13	8
5. Blow-off cocks	191	325	442	469	650	780
6. Boiler checks	263	521	761	914	1,043	1,200
7. Boiler shell	430	579	841	954	1,422	1,888
8. Brake equipment	1,923	2,706	3,894	5,214	6,572	7,062
9. Cabs, cab windows, and curtains	1,484	3,066	2,140	1,670	2,055	2,666
10. Cab aprons and decks	415	710	1,005	852	1,086	1,307
11. Cab cards	211	226	305	378	575	696
12. Coupling and uncoupling devices	98	122	154	179	289	394
13. Crossheads, guides, pistons, and piston rods	856	1,421	1,887	2,088	2,602	3,018
14. Crown bolts	96	95	129	164	235	334
15. Cylinders, saddles, and steam chests	1,265	2,311	3,210	3,264	4,526	5,080
16. Cylinder cocks and rigging	411	648	967	1,007	1,634	1,904
17. Domes and dome caps	83	154	227	281	388	463
18. Draft gear	568	950	1,310	1,453	2,037	2,634
19. Draw gear	640	1,003	1,367	1,650	2,210	3,140
20. Driving boxes, shoes, wedges, pedestals, and braces	925	1,359	1,993	1,990	2,710	3,342
21. Fire-box sheets	341	471	657	730	796	1,129
22. Flues	187	254	334	464	465	556
23. Frames, tailpieces, and braces, locomotive	740	1,271	1,377	1,354	1,682	1,973
24. Frames, tender	105	177	297	256	264	373
25. Gauges and gauge fittings, air	192	290	309	461	721	886
26. Gauges and gauge fittings, steam	324	553	678	969	1,425	2,038
27. Gauge cocks	415	783	1,114	1,413	2,024	3,068
28. Grate shakers and fire doors	410	767	295	377	613	720
29. Handholds	562	865	1,125	1,373	2,285	3,100
30. Injectors, inoperative	55	103	86	93	84	78
31. Injectors and connections	1,815	3,275	4,484	5,563	7,188	8,303
32. Inspections and tests not made as required	4,862	7,456	9,246	6,623	8,889	10,646
33. Lateral motion	289	372	618	699	673	758
34. Lights, cab and classification	77	119	121	118	107	106
35. Lights, headlights	180	373	488	571	835	946
36. Lubricators and shields	176	312	423	500	746	883
37. Mud rings	318	445	636	822	1,073	1,458
38. Packing nuts	523	828	991	1,265	1,851	2,772
39. Packing, piston rod and valve stem	706	1,429	1,708	1,904	2,214	2,489
40. Pilots and pilot beams	160	272	371	386	507	638
41. Plugs and studs	182	348	482	619	740	1,087
42. Reversing gear	299	579	788	967	1,247	1,539
43. Rods, main and side, crank pins, and collars	1,520	2,488	3,465	4,152	5,137	5,683
44. Safety valves	61	116	170	172	212	270
45. Sanders	314	804	1,008	1,031	1,268	1,769
46. Springs and spring rigging	2,161	3,311	4,557	4,939	5,956	6,826
47. Squirt hose	184	313	387	478	644	975
48. Stay bolts	293	395	542	590	631	905
49. Stay bolts, broken	938	1,098	1,197	1,867	2,373	3,582
50. Steam pipes	512	730	925	1,020	1,308	1,587
51. Steam valves	226	399	471	708	774	962
52. Steps	676	1,021	1,394	1,817	2,440	3,227
53. Tanks and tank valves	732	1,426	1,717	1,931	2,747	3,430
54. Telltale holes	151	183	174	241	377	487
55. Throttle and throttle rigging	574	1,175	1,554	1,889	2,233	2,618
56. Trucks, engine and trailing	714	1,141	1,605	1,914	2,363	2,860
57. Trucks, tender	1,059	1,531	2,144	2,610	4,114	4,929
58. Valve motion	497	827	1,067	1,262	1,568	1,576
59. Washout plugs	815	1,283	1,871	2,211	2,786	3,649
60. Train control equipment	9	48	60	112	.....	.....
61. Water glasses, fittings, and shields	955	1,501	1,816	2,115	2,973	3,621
62. Wheels	750	1,025	1,325	1,609	2,119	2,243
63. Miscellaneous—Signal appliances, badge plates, brakes (hand)	418	691	1,101	1,273	1,511	1,746
Total defects	36,968	60,292	77,268	85,530	112,008	136,973
Locomotives reported	60,841	61,947	63,562	65,940	67,835	69,173
Locomotives inspected	101,224	100,794	96,465	100,415	97,227	90,475
Locomotives defective	10,277	16,300	20,185	24,051	29,995	36,354
Percentage of inspected found defective	10	16	21	24	31	40
Locomotives ordered out of service	688	1,200	1,490	1,725	2,539	3,281

Cast-iron tender-truck wheel which had 63 cracks in the tread—Some of the cracks extended into the flange

Boiler Explosions or Crown-Sheet Failures

As in former years, boiler explosions caused by crown-sheet failures continue to be the source of most of the fatal accidents; 93.7 per cent of the fatalities during the year occurred from this cause as compared with 84.6 per cent for the previous year. It has been pointed out in former reports that the increasing size of locomotive boilers and the higher pressures carried therein tend to increase the violence of explosions and cause increase in the average number of casualties per accident. Notwithstanding, there has been a marked decrease in the number of boiler explosions and firebox failures as the result of low water and other causes.

(Concluded on page 17)

Servicing Passenger Cars At Terminals

By A. W. Berger*

The need of wide-awake organization, careful attention to details and regular assignments of trains is pointed out in Chicago Car Foremen's Association paper †

THE terminal servicing of passenger equipment, taking into consideration the various operations necessary from the time that a passenger car arrives in the coach yard from road service and is placed in serviceable condition, both from a standpoint of safe operation and cleanliness, is quite a problem, as those who are familiar with the operation of passenger equipment readily realize.

The keen competition evident in the present day and age has brought about considerable changes in transportation. Added attractions, such as radio, interior design, improved ventilation, cooling units and many other features made necessary to meet the rapid changes, have materially added to the comfort of the traveling public, as well as to the number of equipment details which can get out of order.

In the first place, the staff of supervisors at a coach yard, referring to the larger coach yards, usually consists of a general car foreman, assistant general car foreman and the required number of assistant foremen who supervise the various classes of employees, such as mechanics and coach cleaners necessary to place in presentable condition and insure safe operation of passenger trains assigned under their jurisdiction.

Mechanics and Coach Cleaners Have Regular Train Assignments

The operations pertaining to maintenance and cleaning of the passenger equipment are assigned to the various classifications of mechanics and coach cleaners. By that I mean that all of the mechanics and coach cleaners have regular assignments of trains, certain work, such as that of the tinners, pipe fitters, and special operations pertaining to cleaning, not being assigned in this way.

One of the first operations, and an item of importance, is the inspection of through equipment on arrival off the road in the passenger station. Inspectors at the depot are assigned for this purpose, it being their duty to inspect trains inbound for anything that may be dragging to prevent damage to interlocking plants, and reinspect equipment outbound for any defect which may have developed en route from the coach yard.

A feature of material importance on passenger equipment inbound off the road is the inspection of journal boxes, which should be felt with the bare hand to determine the running temperature. Journal bearings running above normal temperature should be denoted with an "X" and those running O. K. with an "O." A journal box marked with an "X" denotes to the inspector or car oiler in the coach yard that this particular journal box has been heating above normal temperature, and his duty is to jack up the journal box, examine the journal, journal bearing, etc., and correct the trouble.

In this manner, any number of hot boxes are eliminated, which would be practically impossible in the majority of instances with no evidence of previous heating outside of feeling journal boxes for running temperature. This, of course, would not be practical after arrival of the equipment in the coach yard, because the journal boxes would be cooled off.

On arrival of passenger equipment in the coach yard,

Coach yard, repair track and other facilities of the Chicago & North Western at California avenue, Chicago

* Mr. Berger is assistant master car builder of the Chicago & North Western, Chicago.

† Presented at the November 9 meeting of the association, held at the Auditorium hotel, Chicago.

the first and most important operation is the inspection. To insure safe operation and to avoid delays en route, it is highly important that a thorough inspection be made and that inspectors assigned to this important phase of operation be capable and entirely familiar, especially with the running draft gear, etc., and have a knowledge of the A.R.A. rules pertaining to passenger equipment. Inspectors should be free from other duties, it being understood, of course, that their assignment is such that it will keep them employed during their entire period.

Inspectors should have an assignment of trains inbound, and one of their first duties should be to place themselves in a position where they can check equipment for slid flat wheels while trains are backing into the coach yard. This is very important as it is practically impossible to detect flat spots on wheels after a car is standing still, unless the spots are visible or a report is furnished by the train crew. The equipment should then be followed up and inspection completed before each train is broken up and the cars placed in line on their respective outbound trains to avoid unnecessary switching, which is costly.

Particularly should a thorough inspection be made of wheels, proper side-bearing clearance, elliptic and helical truck springs, couplers and draft gear, brake beams, brake-beam hangers, connection pins, cotter keys, brake-beam release springs, safety straps, etc. As the cars are marked bad order for the various defects requiring repairs on the repair track, the yardmaster should be notified, as well as the repair-track foreman. In this manner, the yardmaster will be in a position to spot cars according to their departure from the coach yard and the foreman on the repair track should arrange for repairs accordingly.

The light running repairs are chalk-marked and completed in the yard, running repairmen being assigned to a certain number of trains and held responsible accordingly. These repairmen are assigned in pairs, each man to his respective side.

Repair-track forces comprise a foreman and the required number of truck repairers, according to the average number of bad orders handled. These men are formed in gangs, usually four men to each gang, as follows: One man in the pit to operate jacks, remove brake connections, etc., and the balance of the men above the pit to remove tie straps, springs, pedestals, jack up of the car body, etc.

In this connection, it is also essential that the repair-track foreman personally inspect cars as they are placed on the repair track, not only for the defect which has shopped the car, but for a general inspection of the trucks, draft gear, couplers, etc. He must arrange to correct conditions which may in a short period necessitate reshopping of the car and thereby unnecessarily penalize the company.

Passenger Journal Boxes Repacked Every Four Months

A feature of great importance both in passenger and freight-train operation is the lubrication of journals. All concerned fully realize the importance of operating passenger and freight with a minimum delay. Hot-box delays are not only costly from an operating standpoint, and increase maintenance cost, but also possibly even more serious, cause delay which is apt to result in the loss of passenger business and freight shipments.

In order to minimize hot-box delays, a definite period should be set for the repacking of journal boxes, examination of journal bearings, journals, wedges, etc. In this manner, conditions are detected which cannot be discovered by ordinary inspection, especially cracked and loose liners, glazed packing and waste grabs, which are not visible. The repacking period should be at least once every four months. This practically entirely prevents packing from becoming glazed and, in addition, through renovation, eliminates the short strands and restores elasticity.

The assignment for this operation should be comprised of a special gang consisting of two inspectors and one helper. The inspectors working on opposite sides, jacking up journal bearings consecutively, completing their inspection of bearings, journals, wedges, etc., and the helper removing old packing, delivering it to the renovating plant and repacking journal boxes complete on home equipment.

It is also of the utmost importance that the regular routine of inspection and servicing of journal boxes be lined up in a systematic manner. Careful inspection should be made of each and every journal box, especially for low journal bearings, waste grabs, cracked bearings, cut or rough journals, tilted journal boxes, etc., and to see that the packing in the journal boxes is properly dressed. Inspectors assigned to these positions should be capable and fully familiar with the various phases pertaining to the lubrication of journal boxes. A regular assignment of trains should be set aside for each inspector, which will not only assure proper inspection and servicing of journal boxes, but also place the responsibility directly where it belongs. The packing removed is taken to a renovating plant where it is thoroughly washed, car-oil filtered and re-used.

Roller-bearing equipment, as all familiar with it know, needs possibly more exacting care than the standard friction bearing, in that all parts must be machined perfectly and measure up to the necessary requirements. Where a sufficient number of cars are operating equipped with roller bearings, it pays to assign a mechanic to the servicing of roller bearings exclusively, checking the oil level, and renewing defective and worn-out parts in the yard. In addition, extreme care should be exercised where cars are placed on the repair track for change of wheels, calipering all parts for limits of wear, pitted condition of rollers, races, etc.

Air Brakes Cleaned at Six-Month Intervals

The cleaning and daily testing of air-brake equipment is also of the utmost importance. Air-brake cylinders should be cleaned, oiled and tested according to the A.R.A. requirements, and particular care taken to see that safety valves are uniformly adjusted. In fact, on the Chicago & North Western, we clean, oil and test the air brakes every six months on passenger equipment. This positively assures good operation and eliminates any opportunity of cars exceeding the 12-month period. This operation is assigned solely to one air-brake repairer and helper, the helper being necessary to assist in cleaning large cylinders and especially applying and removing the U. C. valve. The triple valves removed are cleaned, oiled, repaired and tested on test racks meeting the A.R.A. requirements.

Daily testing and adjusting of air brakes on passenger trains are taken care of by regular air-brake inspectors, such inspectors being assigned a certain number of trains and held responsible accordingly. Each inspector is equipped with a portable test truck. It is his first duty to walk around the train, see that all angle cocks are opened, hose coupled, bleeders closed and rear angle cock closed. Application of the air connection can then be made without any danger of loss of air. The inspector then checks the main for leaks, applies brakes with the service test, measures the piston travel, re-

leases the brakes by a slow rise in the brake pipe pressure to determine the condition of the triple-valve main piston ring and makes necessary adjustments. Care should be exercised to see that the retainer valves are also tested according to the A.R.A. requirements.

Pipe and sheet metal work is assigned to a certain number of pipe fitters and tinners, depending on the number of cars handled and the class of equipment. These men, while assigned to a certain number of trains, are more or less free to cover any portion of the yard, especially the pipe fitters. It is the latters' duty to repair pipe breakages, steam, air and water, to remove filters and make repairs to the water pressure system. The various mechanics, such as air-brake inspectors, hose couplers and waterman report breakages when these are noted, either by phoning the office with the local yard phone or reporting such defects to the supervisor in direct charge.

Meeting Winter Conditions

As we all know, winter brings considerable trouble to a coach yard, especially to steam-heat apparatus and water works. To eliminate considerable trouble and to avoid delays due to steam-heat failures, a thorough campaign should be conducted in preparation for the winter months. Pipe fitters should be assigned during the summer months for the purpose of repacking end valves, overhauling regulators, replacing lagging on steam train lines and branch pipes, and repairing metal connectors, yard connections, etc.

Another feature of importance is the Baker hot-water heating system. While the draining, blowing out of dirt, scale, etc., and recharging of a heater with water usually lasts from shopping to shopping, there are times when this becomes necessary in service, due to pipe breakages, holding cars out of service and placing them in storage where no steam is available to keep the cars warm or possibly to avoid expense through the use of fuel. In such instances, care should be used that that system is properly drained during the winter months to prevent freezing.

Baker heaters, when in use, should be checked daily, especially the water level, and the safety valve should be tested at least once every six months to prevent any possibility of corrosion from salt water preventing the safety valve from functioning and releasing excessive pressure. To assure proper care, a special assignment is necessary, especially where a sufficient number of cars equipped with Baker heaters are in service. It is also important that Baker heaters be properly kindled ready for fire, coal chutes filled and fires looked after regularly to avoid overheating. Proper checking avoids waste of fuel, and the ash pan must be kept clean and free from ashes. This likewise is a special assignment during the winter months and is usually handled by a reliable coach cleaner.

The number of tinners employed is governed by the cars handled requiring this class of work. Their duties consist of repairing metal roofs, water coolers, gravity tanks, hoppers, wash stands, and kitchen ranges and cleaning of filters. The tinners should, like the pipe fitters, be assigned to a certain number of trains as far as practicable, covering the trains in their assignment and repairing defective conditions as they are found. It is understood, of course, that supervisors, in checking equipment under their jurisdiction and finding repairs necessary in advance, should assign such work in accordance with train departure, especially during the winter months when this class of work is more prevalent.

Interior Details Which Should Receive Special Attention

Interior work such as painting, carpenters' duties, upholstering, etc., are also of vast importance, especially so under present conditions when it is impossible to shop cars regularly due to the reduction in forces. The duties of a coach carpenter are many, such as the replacement of window glass, repairs to locks, doors and seats, replacing worn aisle strips, replacing gas globes and shades, repairing and adjusting door checks, renewing weather stripping, etc. Particular attention is necessary during the summer months to the care of window sash, so that windows can be raised without effort by the traveling public. In addition, sash locks and stops should be thoroughly checked daily to see that they are in proper condition to avoid any possibility of windows dropping and resulting in claims due to personal injury. Other items of importance are adjusting door checks to prevent doors from standing ajar or slamming, repairing inoperative doors, especially side doors on baggage and mail cars.

Touching up with paint on the interior as well as the exterior is also very essential, especially on first-class equipment, such as parlor cars, diners, cafe cars, lounging cars, etc. The furniture on the interior as well as the exterior finish receives many abuses through carelessness on the part of the traveling public, they, of course, or at least the majority, being under the impression that railroads have endless resources and that a little damage, more or less, means nothing.

Features in particular which are very noticeable and seem to receive the maximum of abuse and wear are the chairs, window sills, doors, tables and writing desks. Touching up these features and keeping them neatly refinished adds materially to the interior of the car.

A view at the crossover where passenger-car conditioning and supply operations are carried on

Steam, water pipes and foot rests should also be kept neatly painted, as pipes scale frequently and present an unsightly appearance.

Exterior painting is also of the utmost importance and should be taken care of during favorable weather conditions. Features in particular which should be given constant attention are the window frames, vestibule doors, roofs, belt rail, battery boxes, steps, buffer wings and foot plates. A painting job of importance is what might be termed dressing up the rear ends. Rear-end cars on the important trains, especially trains equipped with observation cars, should have the railings cleaned and the coupler face and end sill, safety chains, etc., painted daily with a light quick-drying spray paint, which sets off the rear end prominently when placed in the train shed for the receiving of passengers.

Men who do this work, similar to the coach carpenters, should be assigned to certain trains, with the exception, of course, that it becomes necessary at times where more than one painter is required on a certain class of work to complete painting before departure of the train. This usually happens on important special trains requiring preferred attention, or possibly when painting the interior complete on mail cars and exterior on certain cars which cannot be relieved for shopping.

Another class of repairs essential in a coach yard is the upholstering of chairs, coaches, seat cushions, seat backs, repairs to window shades, carpets, rugs, and portiéres. Upholsterers are assigned for this purpose; have a regular assignment of trains; and are required to keep in repair all items coming under their classification. By proper maintenance of this feature, not only is a saving effected in material, but also the shops are relieved.

The servicing of passenger equipment from a cleaning standpoint is quite a problem in itself, although this feature is generally looked upon as less important insofar as safe operation is concerned. It is equally important from a sanitary standpoint and essential as an advertising medium.

Similar to all other operations on a railroad, the car-cleaning features must be handled in a systematic manner. From past experiences, it has been found that the interior cleaning of passenger equipment is handled far more efficiently by arranging coach cleaners in gangs on the interior and cleaning cars completely, particularly when cleaning through equipment.

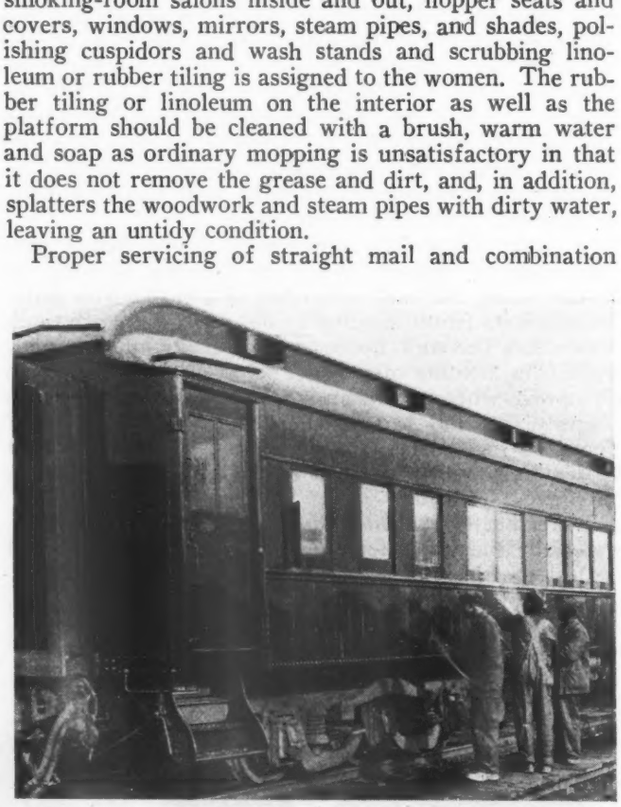
Proper Sequence of Cleaning Operations Vital

Where car cleaners are assigned to individual operations, it not only adds to the traffic through the cars, but invariably cleaners who are assigned to separate operations such as sweeping, mopping, dusting, polishing and woodwork, seat arms, window sills, etc., will have their work completed and the top cleaner will follow with the wiping of deck sash or ventilators, molding, lamps, basket racks, etc.; and just about undo work that already has been performed. This results in the car having the appearance of being poorly cleaned, due to the fact that the accumulation of dust and dirt from the tops or ceilings of cars has been disturbed, which naturally falls downward and settles on the woodwork, seats, floor, etc., which have received previous cleaning.

Interior coach gangs should be comprised of a man and two women with a regular assignment of cars according to train departure. The man in each gang does the heavier work, such as cleaning deck sash, gas and electric lamps and fixtures, moldings, tops of salons, basket racks, vestibules, handholds and raising of double windows for cleaning. The women turn seats, sweep and mop the floor, wipe the windows, mirrors and woodwork completely, including window sills, seat arms, and the outside and inside of the salons, dust the shades, polish wash stands, sponge foot rests over the steam pipes, wash the exteriors of the hopper bowls, dust the seats and backs and clean cuspidors and hopper seats and covers. The latter features of cleaning are equally distributed between the two women.

The same method is followed in cleaning the interior of the parlor, dining buffet, observation, lounge cars, etc., only that two coach cleaners are assigned to each gang, preferably a man and woman, on account of the assignment of cars not being nearly so heavy as that of the coach gangs. All top work similar to the coach gangs is taken care of by the man, who also cleans vestibules, especially buffer wings and around the brake staff, and assists the woman in raising double windows. Wiping of the woodwork below basket racks, dusting the chairs, wiping the leather sofas and chairs in the smoking-room salons inside and out, hopper seats and covers, windows, mirrors, steam pipes, and shades, polishing cuspidors and wash stands and scrubbing linoleum or rubber tiling is assigned to the women. The rubber tiling or linoleum on the interior as well as the platform should be cleaned with a brush, warm water and soap as ordinary mopping is unsatisfactory in that it does not remove the grease and dirt, and, in addition, splatters the woodwork and steam pipes with dirty water, leaving an untidy condition.

Proper servicing of straight mail and combination



Car exterior being washed by three men, one equipped with a hose, and the other two with long and short-handled brushes

mail cars is also important for the reason that usually a contract is entered into with the U. S. government, specifying certain requirements, and failure to comply with them results in the railroad companies being penalized. Care should be exercised in cleaning this class of equipment, referring particularly to the mail racks, sorting tables, windows, floors, letter cases, cinder guards, skylights and deck lights, and maintenance of emergency equipment and equipment standard to this class of car. The cleaning of this equipment is handled similarly to coaches, each gang having its specific assignment.

Individual cleaning features, such as washing headlining, blowing cars and carpets, vacuum cleaning of seats, cushions, sofas, etc., cleaning double windows

from the exterior, changing linen in parlor and chair cars, cleaning oil and gas lamps in the baggage cars, sweeping the platforms and baggage cars and washing of fish pans and racks, cleaning of hoppers, icing of water coolers and refrigerators, and watering of overhead and pressure tanks are assigned as individual operations and are handled separately and distinctly from interior gangs. Special assignments for this purpose are necessary, not only from an efficiency standpoint, but it would also be impracticable to burden interior cleaners with the cleaning facilities necessary and expect efficient operation. The refuse swept up on a platform and in baggage cars is disposed of in an incinerator.

The headlining washers comprise three to a gang. These gangs should be equipped with light wooden horses to reach the top and side deck of the car, a good oil soap, two buckets, one for rinsing and one for soap, a sponge, a hand brush, and a chamois or cloth. The best results are obtained by using warm water with soap, applying it with a brush, wiping the soap water off thoroughly with a sponge and cold water, then using the chamois or raw silk cloth to dry the surface washed. Particular care should be taken in removing the soap. If not thoroughly washed off, it will burn and damage the paint and varnish. The present light colored headlining applied solely for better illumination requires more frequent washing, especially around the ventilators, depending, of course, entirely on the class of service in which the car is operating; therefore, cleaners assigned to this class of work are not assigned to any particular cars or trains. They are assigned from day to day where the condition warrants.

Both Blowing and Vacuum Used on Car Interiors

In blowing cars and carpets, the men assigned to this feature work separately, with the exception of the carpet gang who work in pairs, as the carpets must be picked up, folded, rolled and taken to the carpet rack for cleaning. The cleaners assigned to interior blowing and vacuum cleaning on cars complete have a regular assignment of trains, regardless of consist, and each individual blowman is required to keep his assignment in condition. Similar to the headlining, no definite period can be set for blowing or vacuuming of cars, as it depends on the territory in which the car operates. Cars in coast service need attention daily on every trip; cars in local service about once a month. The season of the year is also a deciding factor. In order to obtain the best results in blowing of carpets, the carpet racks should be of a solid platform type. The nozzle should be placed underneath the carpet or between the carpet and platform which causes a wavy motion, loosens sand and dirt, or, in other words, boils the carpet bringing dirt to the top of the nap which then can be easily blown off.

Exterior of the windows and the outside of the inside sash are cleaned from the outside with the use of a special ladder which is placed against the side of the car. A window stick is inserted between the sash with a rag and worked back and forth until the window is cleaned. On windows covered with grease or rust, a cleaner should be used to assist, as it is impossible to remove grease or other foreign substances which adhere to windows with a dry rag. Cleaners assigned for this purpose work usually in pairs, each cleaner assigned to his respective side.

The cleaning of hoppers should likewise be considered a specialty operation. Cleaners for this purpose are assigned to certain trains, cleaning hoppers daily with a solution of soap and disinfectant.

The icing of water coolers, refrigerators and filling of gravity or pressure water tanks are also specific assignments. Each ice and waterman has his regular assignment of cars and is equipped with the necessary facilities to handle his part of the work. It is exceedingly important that the waterman be equipped with a nozzle and disc and have the latter fastened to the end of the hose which is inserted in the filling tube on cars. This will prevent dragging the end of the hose on the ground and possibly accumulating dirt and germs. Another item of importance is in the steaming of water coolers. This should be done at least once every seven days and tanks sterilized with steam for a period of three to five minutes. A steaming table should be arranged for this purpose and, where the assignment of cars is large enough, it pays to have a special assignment.

Icing of refrigerators in dining cars is handled by the iceman who handles the icing of the coolers. In other words, the iceman does all of the icing on the trains assigned to him, regardless of consist. Removal of garbage from dining cars is taken care of by the cleaners who are assigned to cleaning kitchens. The assignment of these positions depends largely on the number of cars handled and, if sufficient, warrants a special assignment.

On the most important trains to conform with the class of cleaning in general, the trucks should not be overlooked, as oiling then puts on the finishing touch which sets off the train.

Method of Keeping Car Exteriors Clean

The exterior cleaning, referring especially to the car body, is, of course, the major operation in its respective classification. The exterior appearance of a train usually reflects the type of cleaning prevalent. There is nothing more important than to have the exterior of a car in neat and trim order when the car is taken to the depot for the receipt of passengers. The traveling public, as we all know, is finicky, and a bad impression is created when the exterior is improperly cleaned. General criticism automatically results.

The exteriors should be washed daily by regular wash gangs composed of men of which there are three to a gang. Each gang is equipped with approximately 125 ft. of water hose and two car-wash brushes with long and short handles. One man operates water hose, spraying the car in advance of washing and thoroughly rinsing the car, and the other two men complete the brushing. The cleaner with the long-handled brush washes from the letter board down to the belt rail, including the windows. The cleaner with the short-handled brush washes the lower skirt, or wainscoting.

Special Cleaner Sometimes Necessary

However, there are periods when a special cleaner is necessary. Dirt and grease accumulate around rivet heads and the car, in general is in need of a thorough scrubbing. Usually oxalic acid is used for this purpose, which is very effective and, if properly used, will not affect the exterior finish. Oxalic acid solution should be prepared in advance, preferably in 50-gal. barrels with the covers locked. The acid washing is handled similarly to ordinary washing with the exception that approximately one-quarter of the car should be completed at a time to prevent the acid from drying and the chemical action injuring the exterior finish, especially so on extremely hot days.

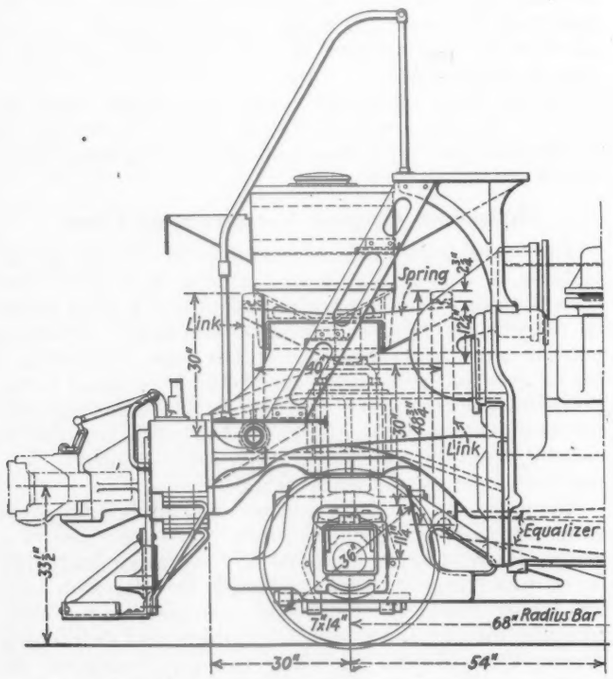
Newly-painted cars should not be acid-washed for at least a period of sixty days, which positively assures that paint and varnish is sufficiently hardened to permit the use of the acid solution safely.

Western Pacific Single-Expansion Articulated Locomotives

Six 2-8-8-2 types built by Baldwin hauling fruit trains of 3,750 tons through the Feather River Canyon — Purchased to replace 2-6-6-2, 2-8-2 and 2-8-0 type locomotives previously used double-heading to handle equivalent tonnage

SIX single-expansion articulated 2-8-8-2 type locomotives purchased last summer by the Western Pacific from the Baldwin Locomotive Works are, according to preliminary tests, handling the required tonnage with approximately the same fuel consumption as that used by two locomotives formerly employed to do the same work.

Prior to the acquisition of the six new locomotives, trains were hauled from Oroville, Cal., to Portola, Cal., on the third district of the Western division, by two compound 2-6-6-2 type locomotives, one 2-6-6-2 and one 2-8-2 type locomotive, or by 2-6-6-2 and 2-8-0 type locomotives. The third district, the profile of which is shown in one of the illustrations, is 116.31 miles long and has 32 tunnels, the longest of which is located east of Spring Garden, Cal. This tunnel is 7,317.69 ft. long. The locations of the tunnels are indicated by the vertical marks on the profile line. This district has a total of 385 curves, of which 49 are between Oroville and Las Plumas, 101 between Las Plumas and Belden, 111 between Belden and Keddie, 56 between Keddie and Spring Garden, and 68 between Spring Garden and Portola. Of the total 116.31 miles, 4.14 miles are through tunnels, 14.27 miles are on curves from 6 to 8 deg., and 9.85 miles are on curves from 8 to 10 deg. Only 46.03 miles are tangent track.



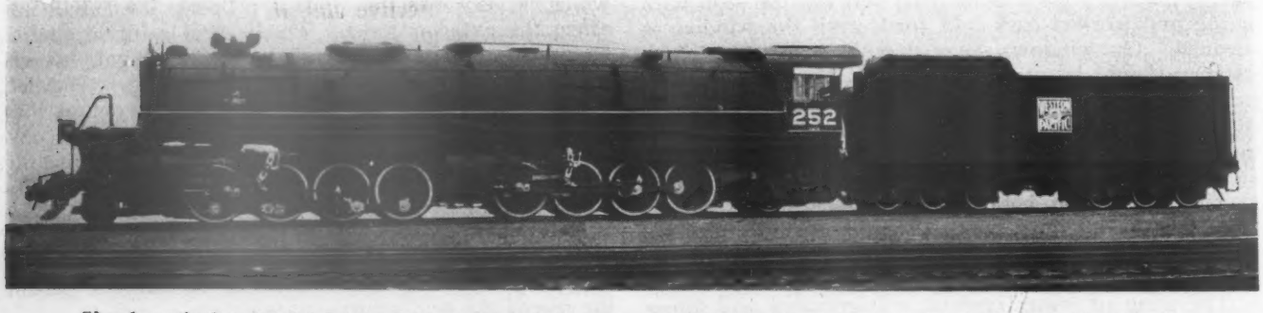
Link and spring arrangement over the engine truck

The six 2-8-8-2 type locomotives were purchased to replace the smaller type locomotives which were required for service over the Northern extension. As shown on the map, this extension connects the Western Pacific with the Great Northern at Bieber, Cal. It was opened to freight traffic November 10, 1931, following the driving of a golden spike which culminated the ceremonies celebrating the completion of the year's most important project of new line construction.

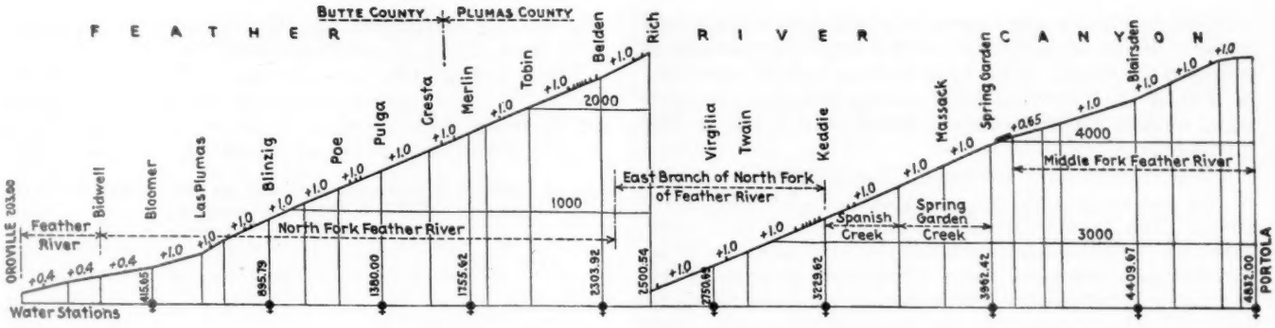
Location of the Extension

Keddie, the southern terminus of the extension, lies in the Feather River Canyon on the main San Francisco-Salt Lake line of the Western Pacific, 281 miles east of the western terminus. Klamath Falls, at the northern end, is the southern terminus of the Great Northern line through Central Oregon from a connection with its subsidiary, the Spokane, Portland & Seattle at Wishram, Ore., midway between Portland, Ore., and Spokane, Wash.

The Western Pacific portion of the line is 112 miles in length; that of the Great Northern is 91 miles in



Simple articulated 2-8-8-2 type locomotive built for the Western Pacific by The Baldwin Locomotive Works



Profile of the line between Oroville and Portola

length. The two railroads also have acquired and completed the construction of the McCloud Branch, 36 miles, extending from Lookout, Ore., to Hambone, where connection is made with the McCloud River railroad. The locomotives formerly used on the Feather River Canyon District, which were replaced by the new 2-8-8-2 type power, are now handling this business.

The new power is designed to handle the greatest possible tonnage in the Feather River Canyon, in which territory, as shown in the profile drawing, there is a

Principal Weights, Dimensions and Proportions of the Western Pacific Single-Expansion Articulated 2-8-8-2 Type Locomotives Built by the Baldwin Locomotive Works Compared to Those of the Locomotives Displaced

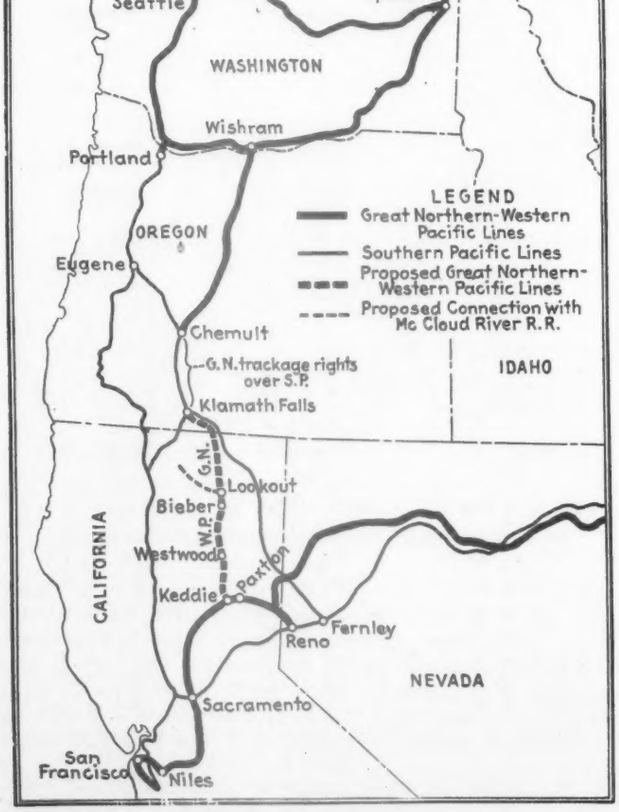
Type of locomotive	2-8-8-2	2-6-6-2	2-8-2	2-8-0
Service	Freight	Freight	Freight	Freight
Cylinders, diameter and stroke	4—26 in. by 32 in.	2—23½ in. by 32 in 2—37 in. by 32 in.	28 in. by 30 in.	22 in. by 30 in.
Valve gear, type	Walschaert	Walschaert	Walschaert	Walschaert
Valves, piston type, size	12 in.	H.P. 14 in. L.P. slide	14 in.	11 in.
Maximum travel	7½ in.	H.P. 6½ in. L.P. 6 in.	7 in.	6 in.
Lead in full gear	3/16 in.	H.P. 1/8 in. L.P. 3/16 in.	1/8 in.	5/32 in.
Cut-off in full gear, per cent	85	88	85	85
Weights in working order:				
On drivers	552,700 lb.	356,500 lb.	249,000 lb.	184,000 lb.
On front truck	48,700 lb.	25,500 lb.	25,500 lb.	19,000 lb.
On trailing truck	63,700 lb.	47,500 lb.	57,500 lb.	.....
Total engine	665,100 lb.	429,500 lb.	332,000 lb.	203,000 lb.
Total engine and tender	1,076,600 lb.	637,800 lb.	599,000 lb.	358,000 lb.
Wheel bases:				
Driving	43 ft. 10 in.	31 ft. 2 in.	16 ft. 6 in.	15 ft. 8 in.
Rigid	11 ft. 0 in.	10 ft. 4 in.	16 ft. 6 in.	15 ft. 8 in.
Total engine	61 ft. 5 in.	49 ft. 10 in.	36 ft. 3 in.	24 ft. 4 in.
Total engine and tender	108 ft. 0 in.	86 ft. 5¾ in.	73 ft. 2½ in.	60 ft. 0 in.
Wheels, diameter outside tires:				
Driving	63 in.	57 in.	63 in.	57 in.
Front truck	36 in.	33 in.	33 in.	30 in.
Trailing truck	42 in.	43 in.	43 in.	.....
Journals, diameter and length:				
Driving, main	12½ in. by 14 in.	10 in. by 13 in.	11½ in. by 14 in.	10 in. by 12 in.
Driving, others	11½ in. by 14 in.	10 in. by 13 in.	10½ in. by 14 in.	9 in. by 12 in.
Front truck	7 in. by 14 in.	6 in. by 12 in.	6 in. by 12 in.	6 in. by 12 in.
Trailing truck	9 in. by 16 in.	8 in. by 14 in.	9 in. by 14 in.	.....
Boiler:				
Type	Straight top	Straight top	Straight top	Straight top
Steam pressure	235 lb.	200 lb.	190 lb.	190 lb.
Fuel, kind	Oil	Oil	Oil	Oil
Diameter, first ring, inside	101 13/16 in.	88 in.	82 in.	78⅜ in.
Firebox, length and width	204⅛ in. by 102¼ in.	108⅜ in. by 96¼ in.	120⅛ in. by 84¼ in.	121 in. by 40 in.
Combustion chamber, length	72 in.	88 in.	36 in.	.....
Tubes, number and diameter	272—2¼ in.	235—2¼ in.	213—2¼ in.	217—2 in.
Flues, number and diameter	75—5½ in.	36—5½ in.	45—5½ in.	36—5½ in.
Length over tube sheets	23 ft.	24 ft.	18 ft.	13 ft. 11 in.
Grate area	145 sq. ft.	72.2 sq. ft.	70.3 sq. ft.	33.6 sq. ft.
Heating surfaces:				
Firebox and combustion chamber	522 sq. ft.	360 sq. ft.	284 sq. ft.	218 sq. ft.
Arch tubes	.....	26 sq. ft.	15 sq. ft.	.....
Thermic syphons	217 sq. ft.	.....	92 sq. ft.	.....
Tubes and flues	6,141 sq. ft.	4,550 sq. ft.	3,407 sq. ft.	2,074 sq. ft.
Total evaporative	6,880 sq. ft.	4,936 sq. ft.	3,798 sq. ft.	2,292 sq. ft.
Superheating	2,152 sq. ft.	1,051 sq. ft.	973 sq. ft.	733 sq. ft.
Combined evaporative and superheating	9,032 sq. ft.	5,987 sq. ft.	4,771 sq. ft.	3,025 sq. ft.
General data, estimated:				
Rated tractive force, 85 per cent cut-off	137,000 lb.	80,000 lb.	60,300 lb.	43,300 lb.
Tractive force, booster	13,900 lb.	.....	11,000 lb.	.....
Combined tractive force, standing	150,900 lb.	.....	71,300 lb.	.....
Weight proportions:				
Weight on drivers ÷ tractive force	4.03	4.47	4.12	4.24
Weight on drivers ÷ total engine weight, per cent	83.0	83.2	75.1	90.7
Total weight, engine ÷ comb. heating surface	73.8	71.8	69.5	67.5
Boiler proportions:				
Tractive force ÷ combined heat. surface	15.2	13.4	12.6	14.3
Tractive force × diam. drivers ÷ comb. heat surface	955	763	795	815
Firebox heat. surface, per cent of evap. heat. surface	10.73	7.84	10.3	9.53
Superheat. surface, per cent of evap. heat. surface	30.65	21.35	25.6	31.95
Combined heat. surface ÷ grate area	62.3	83	68	90.2
Tender:				
Type	Rectangular water-bottom	Rectangular water-bottom	Rectangular water-bottom	Rectangular water-bottom
Wheels, diameter outside tires	36 in.	33 in.	33 in.	33 in.
Journals, diameter and length	7 in. by 14 in.	6 in. by 11 in.	6 in. by 11 in.	5½ in. by 10 in.
Water capacity	22,000 gal.	12,000 gal.	15,000 gal.	8,000 gal.
Fuel capacity	6,000 gal.	4,000 gal.	4,000 gal.	3,000 gal.

maximum one per cent opposing grade to the eastbound traffic. Each of the new 2-8-8-2 type locomotives is required to handle 4,000 tons in drag service over this district of 118 miles and 3,750 tons in perishable freight-train service at the maximum speed permissible in this territory.

They represent the maximum that could be provided within the restrictions of curvature, grades and clearances. The preponderance of traffic in the eastbound direction is perishable business and, of course, must be handled with minimum delay. Inasmuch as each of the new locomotives will displace two locomotives formerly used to haul the same tonnage, there is a saving of over 50 per cent in time at fuel and water stops, plus the economies to be expected from the operation of one locomotive, modern in every respect, as compared with two locomotives designed and built some years ago.

Features of the Design

It will be observed from the table showing the comparative dimensions and weights of the new and the replaced locomotives that the increased capacity and efficiency was secured with comparatively little increase in weight per pair of driving wheels. The weight carried on the drivers by the 2-8-8-2 type is 552,700 lb., as compared with 356,500 lb. for the compound 2-6-6-2 type and 249,000 lb. for the 2-8-2 type.



Map showing proposed construction which is now completed —The new line connects with the Oroville-Portola district at Keddie

The tractive force of the 2-6-6-2 type is 80,000 lb., which, together with the tractive force of 60,300 lb. of the 2-8-2 type and the tractive force of the latter's booster of 11,000 lb., provides a total combined tractive force at starting of 151,300 lb. when these locomotives were double-headed together.

The rated tractive force of the new 2-8-8-2 types is 137,000 lb. The trailing trucks of the new locomotives are equipped with Franklin boosters which provide a tractive force at starting of 13,900 lb. Thus, a total

List of Special Equipment Applied on the Western Pacific 2-8-8-2 Type Locomotive

Railroad	Western Pacific
Builder	Baldwin Locomotive Works
No. ordered	Six
Service	Freight
Boiler:	
Blow-off cocks	Bird-Archer narrow clearance
Boiler and firebox material	Otis basic steel
Boiler checks	Nathan, 287-A
Cleaning plugs	Housley
Feedwater heater	Worthington, Type S (2)
Feedwater heater	Elesco, Type K-60 (4)
Hinges, front end	Okadee
Injector	Nathan, Type HW, Size No. 17
Lagging	Johns-Manville sectional
Oil burner	Thomas
Staybolts, flexible and expansion	F. B. C.
Staybolts, water space	Lewis iron
Staybolts, radial	Lewis iron
Superheater	Type A
Syphons	Nicholson Thermic
Tubes and flues	National
Throttle	American multiple (front-end) type
Throttle, compensating lever	Jones
Valves, safety	Consolidated, 3½ in.
Valves (for pipes and connections using boiler steam pressures)	Hancock, with MMM metal cone seat and disc
Water column	Alco
Water gages	Edna reflex (2)
Whistle, chime	Hancock
Cylinders and running gear:	
Axles, driving	Standard Steel
Axles, trailing truck	Standard Steel
Bearings, wearing	Magnus
Booster, trailing truck	Franklin
Brake, air	Westinghouse
Brake, air, connections	Barco
Brake foundation parts	American Brake
Connecting rods	Standard Steel
Crank pins	Standard Steel
Crossheads	Standard Steel
Crosshead gibs	Eddystone B iron
Cylinder bushings	Eddystone B iron
Cylinder cocks	Okadee
Cylinder cock air piping	Barco (between front and back units)
Drifting valve	Sellers, 2 in.
Driving boxes, lateral motion, rear of front unit, front of rear unit	Franklin
Driving tires	Railway Steel Spring
Driving wheel centers	Standard Steel
Engine bolts	Lewis iron
Frame casting, trailing truck	General Steel Castings
Frame, front engine-truck	General Steel Castings
Packing, piston rod and valve-stem, metallic	Paxton-Mitchell
Piston rods	Standard Steel
Power reverse gear	Alco Type G
Rings, piston bull, valve bull and packing	Eddystone B iron
Rings, piston packing	Hunt-Spiller
Rod bushing connections (fixed bushing)	Eddystone B iron
Sander	Graham-White
Springs, engine and tender	Railway Steel Spring
Tires, trailing truck	Railway Steel Spring
Valve-chamber bushings	Eddystone B iron
Valve motion	Walschaert
Wedges, pedestal	Franklin adjustable
Wheels, front engine truck, rolled steel	Standard Steel
Cab:	
Bell ringer, air	Viloco
Coupler, engine	National Malleable
Electric fittings	Oliver
Gage, steam, holders	Swanson
Gages, steam	Ashton (2)
Steam heat regulator	Vapor
Steam heat gage	Vapor
Water cooler	Giessel
Miscellaneous:	
Booster steam pipe covering	Johns-Manville sponge felt
Flange oiler oil and steam connection (between front and back units)	Barco
Headlight	Pyle-National
Headlight generator	Pyle-National
Lamps, classification	Pyle-National
Lubricator, cylinder and steam chest	Detroit, four feed
Lubricator, hydrostatic, for booster, feed-water pump, air pump	Nathan, three feed
Medallion plates on tender and numbers for cab sides	General Porcelain Enameling Co.
Oil and steam heat connections for oil	Barco
Painting finish	Duco
Pipe covering	Unarco
Sander-trap air-pipe connections	Barco flexible
Stack, deflector	F. B. Gillette patented hood
Steam connection to heater line to mechanical lubricator	Barco 3V
Storm windows (at sides)	Prime
Wiring fittings	Pyle-National
Tender:	
Back-up light	Pyle-National
Connections between engine and tender	Barco

Coupler	National Malleable
Draft gear	Waugh No. 403
Drawbar, Unit (between engine and tender)	Franklin
Marker lamps	Adams & Westlake
Frame	General Steel Castings
Jacks	Norton
Journal boxes	National Malleable & Steel Castings
Radial buffer (between engine and tender)	Franklin
Rerailer	Buda
Side bearings, truck	Woods anti-friction
Truck frame	General Steel Castings
Wheels, tender truck	Standard Steel

tractive force of 150,900 lb. is developed by the new locomotives, which is only 400 lb. less than that developed by the best combination of power previously used.

The 63-in. driving wheels of the 2-8-8-2 type permit running speeds comparable with the 2-8-2 type and faster than the 2-6-6-2 type. The boiler pressure has been increased to 235 lb., as compared with 200 and 190 lb. for the locomotives displaced. All four cylinders of the new locomotives are 26 in. by 32 in.

Two of the new locomotives are equipped with Worthington Type S feedwater heaters and four have Elesco Type K-60. All six locomotives have Thermic syphons, Alco Type G power reverse gears, Type A superheaters, and American multiple front-end throttles. Thomas oil burners are applied.

Flange lubricators are applied to the front drivers of each unit, and Franklin lateral-motion driving boxes are used on the rear driving wheels of the front unit and the front drivers of the rear unit, to facilitate the negotiation of the sharp curves in the Feather River Canyon district.

The power-reverse quadrant is arranged for a maximum cut-off of 85 per cent and is then blanked until the cut-off arrives at 70 per cent. The booster is automatically cut out as soon as the cut-off is reduced below 85 per cent.

The engine truck is of the swing-bolster type with outside journals. The load on the engine truck is transferred through a single leaf spring mounted on top of the truck center pin and above the deck plate. The front spring link is pinned to the deck plate and the rear spring link is connected to the forward equalizers.

The tenders are of the rectangular water-bottom design with cast-steel frames manufactured by the General Steel Castings Corporation. They have a capacity for 22,000 gal. of water and 6,000 gal. of fuel oil.

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(Continued from page 8)

For instance, during 1912 there were 94 accidents as compared with 14 during 1931, or a reduction of 85.1 per cent; 54 persons killed as compared with 15, or a reduction of 72.2 per cent; and 168 persons injured as compared with 41, or a reduction of 75.6 per cent. This class of accidents can be minimized only by the use of the safest practicable firebox construction, reliable boiler feeding and water level indicating devices, and maintenance of proper water level in the boiler.

Extension of Time for Removal of Flues

Four hundred and fifty-two applications were filed for extensions of time for removal of flues, as provided in Rule 10. Our investigations disclosed that in 34 of these cases the condition of the locomotives was such that extensions could not properly be granted. Seventy-three were in such condition that the full extensions requested could not be authorized, but extensions for shorter periods of time were allowed. Forty-one extensions were granted after defects disclosed by our investigations had been repaired. Seventeen applications were cancelled for various reasons. Two hundred and eighty-seven applications were granted for the full periods requested.

Specification Cards and Alteration Reports

Under Rule 54 of the Rules and Instructions for Inspection and Testing of Steam Locomotives, 845 specification cards and 7,138 alteration reports were filed, checked, and analyzed. These reports are necessary in order to determine whether or not the boilers represented were so constructed or repaired as to render safe and proper service and whether the stresses were within the allowed limits. Corrective measures were taken with respect to numerous discrepancies found.

Under Rules 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, 114 specifications and 6 alteration reports were filed for locomotive units and 6 specifications and 13 alteration reports were filed for boilers mounted on locomotives other than steam. These were checked and analyzed and corrective measures taken with respect to discrepancies found.

Suits for Penalties

Three suits for penalties, involving 44 counts for alleged violations of the locomotive inspection law and rules, were pending in the district courts at the beginning of the year. Judgments in favor of the Government were obtained in 2 cases, involving 14 counts; five counts were dismissed by stipulation or agreement, and penalties imposed on nine counts in the sum of $900. One case, involving 30 counts, was pending at the end of the year.

No formal appeal by any carrier was taken from the decisions of any inspector during the year.

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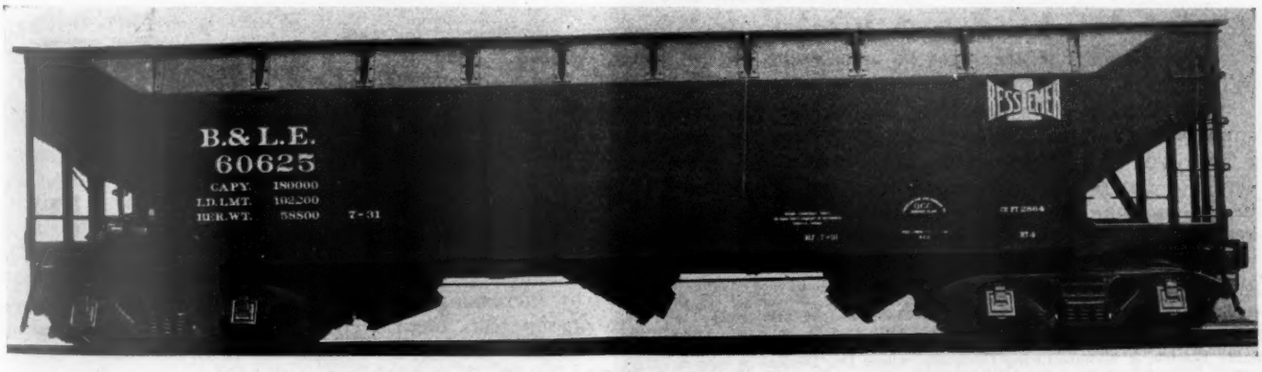

Bessemer & Lake Erie 90-ton hopper built in 1931 by American Car & Foundry

Air Resistance of High Speed Trains*

By O. G. Tietjens and K. C. Ripley†

A study of the economic possibilities for increasing passenger train speeds by reducing the air resistance. The authors base their study on data on the air resistance of train models of various shapes obtained in wind-tunnel tests at the laboratories of the Westinghouse Electric & Manufacturing Company

ONE of the important advantages of the railroad train over the bus is its higher speed. Some American trains have schedule speeds of as high as 50 m.p.h. between important cities, and most of the limited trains travel at about 40 m.p.h. On the other hand, the schedule speed of buses in intercity travel reaches

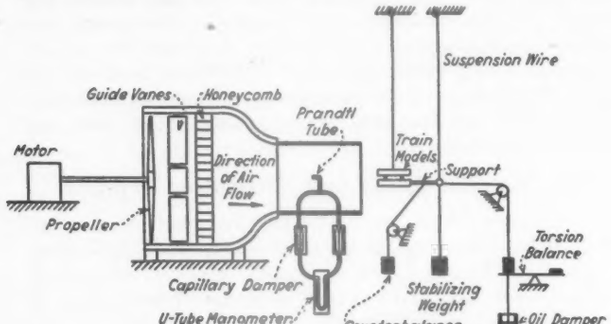

Fig. 1—Schematic diagram of wind tunnel used in tests

nowadays almost 30 m.p.h. or only 25 per cent less than that of the average limited train.

However, after super-highways have been built between the larger and more important cities, there is no reason why the schedule speed of buses cannot be increased to 40 m.p.h. or even higher. This can be done, and without further increase in the power required, by streamlining the shape of the buses. The next important step in the development of bus transportation will likely be in this direction, and it will probably be taken within the next few years. Then the competition of the bus will truly become of vital importance to the railroad.

The other day on the London and Birmingham and on the Great Northwestern Railway a rate of 65 miles an hour was accomplished. The express trains on these lines run at the rate of nearly 50 miles an hour, stoppage included.

This happened more than 80 years ago, and although these records must of course be considered as exceptions, what efforts to increase the speed of trains can be put alongside those made in the cases of ships, automobiles, and airplanes? One remarkable attempt was made a little more than 30 years ago in Zossen, Germany, with the result that with a very heavy and powerful electric locomotive speeds up to 130 m.p.h. were obtained. After having made several runs, however, the rails were spoiled, and the results of the tests offered

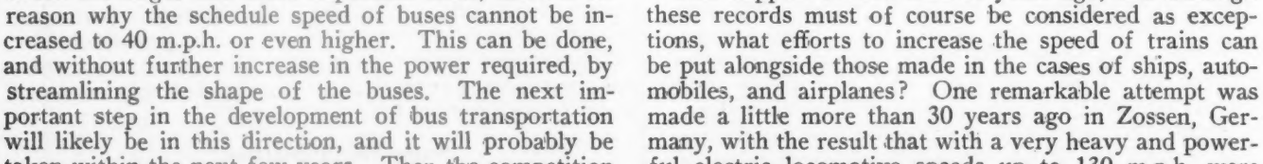

Fig. 2—Models of a present-type train as assembled for tests

What can be said about the railroad and its endeavor to improve its speed? As early as 1845 a record of 45 miles in 52 min. was made in England. At one time the train was proceeding at the rate of one mile in 48 seconds, or "at the astonishing velocity of 75 miles an hour." In the same year the *American Railroad Journal* said:

little encouragement to increase train speed above a certain rate which had been proved to be safe.

A New Approach to Increasing Speeds

Several years ago the matter of designing a new train or coach for high-speed service was again taken up in Germany. This time an endeavor was made to obtain the high speed by decreasing the train resistance rather than by increasing the motive power, as was done in the Zossen tests mentioned. The results of tests recently made with a new type of railway coach, designed by Fr. Kruckenberg, and having a small total

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* Abstract of a paper presented before the American Society of Mechanical Engineers during the annual meeting at New York, November 30 to December 4, 1931. The concluding part of the article will appear in the February issue.

† The authors are connected with the research laboratories of the Westinghouse Electric & Manufacturing Company, where Dr. Tietjens is now in charge of hydrodynamics and aerodynamics.

resistance, proved that in their method the investigators are on the right track. The fact that this coach is driven by a modified airplane propeller is, with respect to the speed obtained, only of minor importance.

The new coach is light in weight (20.6 tons), low in center of gravity, and streamlined, all of which are departures from conventional railway practice. The speed made on an actual run of 173 miles between two large cities was 106 m.p.h. with a top speed of 143 m.p.h., and the run was better by four minutes than the regular passenger-airplane time.

made during the past 30 years. Although the results of these tests differ considerably from each other, they agree that the resistance of a train depends chiefly on its weight and speed. Plotting the resistance for trains of different weight as a function of the speed, it was obvious that the relation obtained could be approximated by a formula such as

$$R = A + BV + CV^2 \ldots\ldots\ldots [1]$$

where A and B are functions of the weight, C a function of the size and the shape of the train, and V the speed of the train.

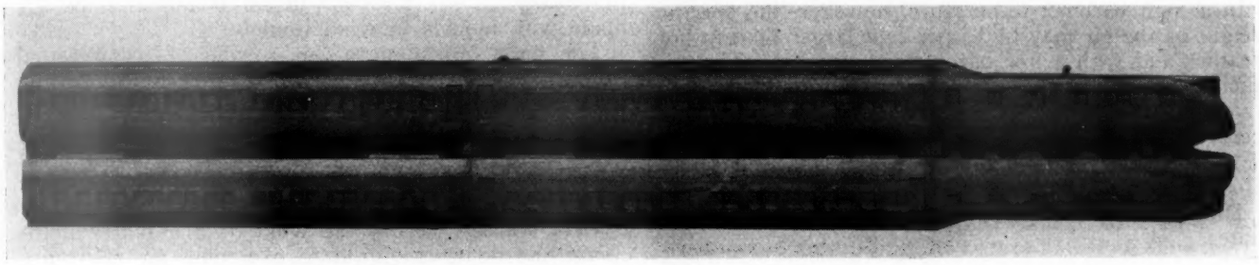


Fig. 3—Models of a streamlined train as assembled for tests

One of the most interesting facts regarding this new German high-speed train is its low energy consumption per mile, chiefly due to its streamlined shape. The coach, carrying 50 passengers, travels 4 miles to the gallon of gasoline. How good an economy this is will be appreciated when it is stated that the power required for coaches of the present type varies almost as the cube of speed; so that an increase of speed from 40 m.p.h. to 100 m.p.h. means a more than tenfold increase in the power required for a coach of a given shape and weight.

If the train is to undertake to compete with the airplane in speed, as seems now to be the next logical development, it is important that the railroads give attention to the design considerations that make the high-speed operation of trains possible without appreciable sacrifice in safety and economy. If the railroad companies do seriously consider this matter of high-speed operation of trains, they will need to evolve some new type of streamlined, light-weight train, and probably make even other radical departures from present practice.

However, even if it be considered inadvisable to increase the speed of trains at the present time, it will be shown later that with existing speeds air resistance is the predominant factor, and that from an economical standpoint streamlining of our fast trains is justified, as is also that of some of our high-speed interurban cars.

For sake of brevity, consideration of the problem of air resistance will be confined here mainly to the case of a train of fixed length—given by that of a locomotive and six coaches—and to that of a single car, as used in frequent schedule service, such as on interurban lines.

Train-Resistance Formulas

Those acquainted with train-resistance work are familiar with some of the common train-resistance formulas that agree in showing one part of the resistance as a function of the weight of the cars in the train, and a second part as a function of the shape and size of the train, assuming a straight, level track. The resistance mainly due to weight is commonly called the frictional resistance, and that due to shape and size, the air resistance.

Extensive experimental tests on the resistance of standard types of trains of various weights have been

It has been proposed to develop an average curve by using all experimental data available, or in other words to establish an equation with an unknown coefficient and to determine this coefficient by means of all test data available. This, of course, is possible; however, it should be realized that such an "average curve" has only slight value due to the fact that the special features of the train corresponding to this curve—the "average train," so to speak—are not known.

If it is impossible, as will be seen later, to devise a single general formula giving the train resistance with sufficient accuracy, one may rightly be of the opinion that there is not much need for a formula which is so simple that one can calculate in a moment the resistance,

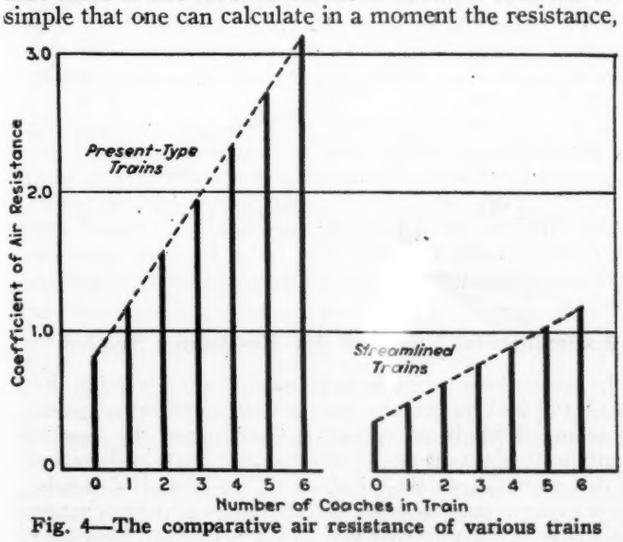


Fig. 4—The comparative air resistance of various trains

but with only ± 50 per cent accuracy. It would be much better to investigate the fundamentals of train resistance. The data obtained by such studies would make it possible to predict with reasonable accuracy the power required. Instead of calculating the total resistance by using one of the many train-resistance formulas, it would be much safer to determine each portion of the total resistance separately, as, for instance, the journal resistance or the air resistance, taking into consideration the particular features of the train.

The coefficient C in the third term of Equation [1], which term represents the air resistance, is usually assumed to be proportional to the cross-sectional area A_1 of the train: or

$$\text{Air resistance} = C' \times A_1 V^2$$

Considering the dimensions in this equation, it will be seen that the coefficient C' is proportional to the ratio of the specific weight γ of the air to the specific gravity, g, or $C' = c(\gamma/g)$. In other words, the air resistance will vary directly with the density of air. This fact has been very often neglected. In cold weather and with a high barometric pressure, however, the specific weight of the air may be 15 per cent larger than in hot weather and with a low barometric pressure. The coefficient C' determined by air-resistance tests made with trains operating under different weather conditions may therefore vary as much as 15 per cent if the difference of the specific weight of the air has not been taken into account.

Therefore, as is common in aerodynamics, we may write:

$$\text{Air resistance} = c\frac{\gamma}{2g}A_1V^2 \quad \ldots\ldots\ldots\ldots [2]$$

This coefficient c by which the air resistance is determined for a train of a given cross-sectional area A_1, moving with a certain speed through quiet air of given specific weight, depends largely on the shape of the train. There is no theory by which this coefficient can be calculated, the only way of determining it for trains of different shapes being by tests.

In some train-resistance formulas the resistance of additional coaches is expressed as a percentage of the air resistance of the locomotive and for long trains this can be done without error. However, it must be emphasized that the manner in which c is split into the two parts c_0 (for the locomotive) and c_1 (for each coach) holds only for a particular kind of train and therefore cannot be used in a general formula for different trains, even though the trains should accidentally have the same c.

It is very often proposed to divide the total air resistance into one portion due to the front pressure, another due to the rear suction, and a third due to skin friction. This distribution is hardly practicable, especially since the third portion, due to what is called skin friction, actually consists also of a kind of pressure resistance because of the space between adjoining coaches.

Experimental Study of Air Resistance Needed

In the authors' opinion it is much more advisable, instead of seeking vainly for a few coefficients applicable to all kinds of trains, to investigate the fundamentals of air resistance. Systematic tests with trains of different shapes would show us on what it depends. Such experiments would teach us how we might change the shape of locomotives and coaches without changing the air resistance, and, on the other hand, what changes of the shape would influence the air resistance.

In this respect, much can be learned from aviation engineers. They have no airplane-resistance formulas, but have had an extended experience with air resistance in general. Numerous tests have been made by using wind tunnels, and if the need arises for an air-resistance coefficient of, say, a new fuselage, they will very likely find tests that have been made with a fuselage similar in shape and which will give a coefficient of sufficient accuracy.

If it is agreed that investigations should be made to clear up the still obscure point of air resistance of trains, there is the question of which method is the most suitable. Here again we may ask the aviation engineers for their advice. Generally speaking, there are two methods of testing: one using actual trains moving through quiet air, and the other employing models of trains in wind tunnels. Both methods have their advantages and both were used in earlier days by aviation engineers. However, it was found that the latter method, of using wind tunnels, was not only more convenient but also more exact, and nowadays practically all the tests on airplanes and airships are made with models in wind tunnels.

The main objection to the method of using actual trains is that the total resistance is first determined and the air resistance then figured as the difference between this total resistance and the frictional resistance determined in a different way. Further, it is very seldom possible to have sufficiently quiet air on the day the tests are being made or a wind of constant uniformity. Even a scarcely perceptible wind of 3 m.p.h. will increase the power required to overcome air resistance about 20 per cent, assuming a speed of 50 m.p.h., and will increase the power required about 50 per cent assuming a speed of 20 m.p.h. This can be easily seen if we take into account that the power required to overcome air resistance varies with the third power of the speed. The speed of the air in wind tunnels, on the other hand, can easily be kept constant to within one per cent.

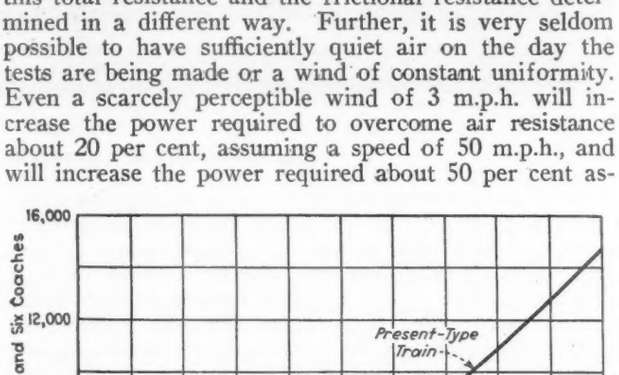


Fig. 5—Resistance in pounds of full-sized trains as calculated from the model tests

Weight of locomotive, 145 tons; weight of each coach, 75 tons; total train weight, around 600 tons—Projected area 126 sq. ft.

Wind-Tunnel Tests on Trains

When the senior author came to the United States about three years ago in order to organize research work on hydrodynamics and aerodynamics at the Westinghouse Electric & Manufacturing Co., East Pittsburgh, he soon realized the great importance of faster transportation in this country. Finding that concern closely connected with the railway business, the development of new features of design of electric locomotives, coaches, and interurban cars was taken under consideration.

The work was started about two years ago by the building of a special wind tunnel for testing models of present-type trains and interurban cars as well as those of a streamlined shape about 1/25 the actual size.

The wind tunnel built for these tests is shown in a

schematic way in Fig. 1. In tests on small-scale models in a wind tunnel it is better, as will be shown in the succeeding part of the paper, to have a turbulent rather than a uniform air flow and therefore, in order to check the characteristics of this particular wind tunnel against those of certain well-known wind tunnels, a preliminary test was made on a 10-in. sphere at various air speeds.

Generally, in constructing the models, a duplicate was made of each train and the two trains assembled as

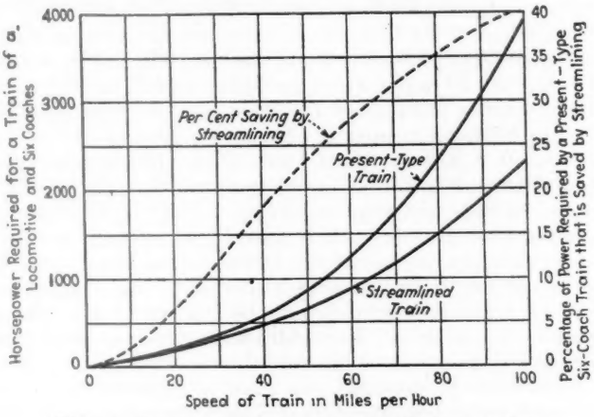

Horsepower Required for a Train of a Locomotive and Six Coaches
Percentage of Power Required by a Present-Type Six-Coach Train that is Saved by Streamlining
Per Cent Saving by Streamlining
Present-Type Train
Streamlined Train
Speed of Train in Miles per Hour

Fig. 6—Power requirements of full-sized trains as derived from Fig. 5

shown in Figs. 2 and 3. This assembly, known as the "mirror method," was used to make the air flow symmetrical about the plane of the imaginary ground, and thus to preserve closely the character of the flow lines occurring with actual trains. From the resistance obtained in testing these assembled duplicates, of course, only half is to be taken for the resistance of a single model. For single cars, such as interurban cars, it was found by experiment that a flat plate parallel to the air flow will give the effect of ground upon a moving train, but with models of long trains the stagnation of air due to a plate stationary with respect to the models would have been for the rear cars objectionably large.

The suspension of the train models in the wind tunnel, and the testing of the air resistance of the models and suspension, and then of the suspension separately to get the air resistance of the models alone, followed conventional practice in these matters. The sensitivity of the test arrangement was sufficient to make the systematic error in the reading of the instruments only about one to two per cent. Damping devices on the torsion balance and on the manometer permitted mean values being read. The tests were made with a range of air speeds of from about 40 to 70 m.p.h.

Air Resistance of Trains

The results of the tests with trains are summarized in Fig. 4. The tests were made on models of a locomotive alone and with one and two coaches for both types of trains. In Fig. 4 the test results have been extrapolated to trains of six coaches. A straight-line extrapolation was assumed to be permissible owing to the fact that practically no difference could be detected between the air resistance of the first and the second coaches in either of the train models.

The values of coefficient of air resistance shown in Fig. 4 are, if anything, probably somewhat high if used for full-sized trains, and especially so for the streamlined trains. The reason is that in the streamlined models most of the resistance is surface resistance, and owing to the complexity of the present-type models, the models, all of the same smoothness of surface, were not smooth as, with more expense, they might have been made. However, the streamlined locomotive, after having been fitted with a streamlined rear part, was tested before and after being highly waxed and polished, and a reduction of over 40 per cent in the air resistance was obtained simply by this change in smoothness of surface.

Since this paper deals only with tests on air resistance, certain assumptions had to be made regarding the frictional resistance in order to determine the total train resistance. After considering various methods of calculating the frictional resistance, the method of A. H. Armstrong was finally adopted: namely,

$$R_f = 50\sqrt{W} + 0.03\,W \times V$$

where R_f is the frictional resistance in pounds, W the weight of a car in tons, and V the speed of the train in miles per hour.

From this expression for the frictional resistance and from Equation [2], in which the coefficients of air resistance obtained from the wind-tunnel tests were introduced, the curves of train resistance of Fig. 5 were drawn, and from these the curves of Fig. 6 showing the power requirements of the trains were readily obtained.

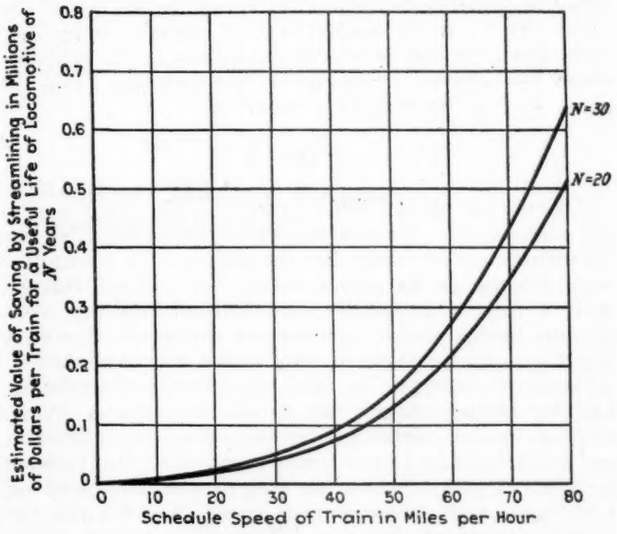

Estimated Value of Saving by Streamlining in Millions of Dollars per Train for a Useful Life of Locomotive of N Years
N=30
N=20
Schedule Speed of Train in Miles per Hour

Fig. 7—The estimated value of adopting streamlining for high-speed trains

To find the significance of the curves of Fig. 6 for the passenger on the one hand and for the railroads on the other, it is necessary to convert them into expressions of dollars and cents' economy.

It is not possible in an elementary study such as the present one to consider in detail or with great accuracy all of the items that enter into the economy of streamlined trains and high speeds over present-type trains and present speeds, but it is possible to show, by giving approximate values to the more important items, that high-speed, light-weight, streamlined trains have sufficiently great economic advantages over present trains amply to justify, apparently, any railroad in adopting them wherever the existing track, right of way, schedules, etc., permit high speeds of, say, 80 m.p.h.

It will be necessary first to justify the use of high speed for trains by considering the cost of high speed to the passenger per mile, after which it will be significant to inquire into the difference in capitalization required for present-type and streamlined trains operating at the same high speeds.

Such difficultly determined items as the saving in labor overhead due to the higher schedule speed, and the in-

creased cost of track maintenance due to the same cause, will not be considered here in figuring the net cost of high speed to the passenger. The items considered will be those due to changes in power rating of the locomotives with increases in schedule speed. For electric operation these items are the expenses due to increased energy consumption, increased cost of the locomotive, and increased cost of the electric transmission system.

In estimating the expense of increased energy consumption with increased speeds a number of assumptions must be made, for which the following values are offered as reasonable for approximate purposes: Let the cost of electric energy at the car wheels be 1.5 cents per kw.-hr. Let the average annual mileage of the train be $100{,}000 \times \frac{V_s}{40}$, where 100,000 is in round numbers the mileage of present passenger locomotives, and V_s is the schedule speed of the train in miles per hour. Since the average resistance of a train for a distribution of speeds about a schedule speed is for any ordinary distribution equal within a few per cent to the resistance at the schedule speed, let the resistance at the schedule speed be taken as the average resistance of the train. If C_A is the annual cost of electric energy per train and P_s is the horsepower required at the schedule speed by either a streamline or present-type train, as given by Fig. 10, it can be shown that

$$C_A = \$28{,}000 \times \frac{P_s}{1{,}000}$$

To find the annual fixed charge C_B per train due to the cost of the locomotive, assumptions such as the following may be made: Let the weight of a locomotive vary directly as its power rating for a fixed voltage, with a 150-ton locomotive developing 2,500 hp. continuous rating, and let the cost of the locomotive vary directly as its weight according to the approximate formula of 50 cents per lb., with or without streamlining. Let the annual straight rate on the locomotive investment to cover interest, taxes, depreciation, insurance, and incidentals be 15 per cent. Let the locomotive have a sufficient power rating to maintain continuously on a straight, level track a train speed of 1.4 times the schedule speed of the train. Then

$$C_B = \$12{,}600 \times \frac{P_s}{1{,}000}$$

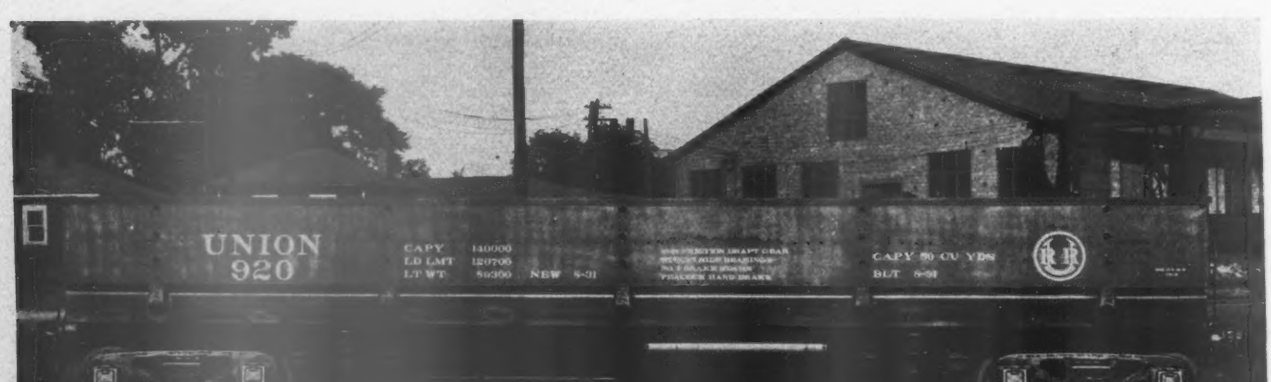
If it is assumed that the ratio between the cost of the transmission system for an electrified railroad, including substations and overhead lines, to the cost of the electric locomotives will, for present purposes, be 2:3, with an annual rate for figuring fixed charges of 15 per cent, the total annual cost C_{ABC} of the three items that have been considered will, in round numbers, be

$$C_{ABC} = \$50{,}000 \times \frac{P_s}{1{,}000} \quad \ldots\ldots\ldots [3]$$

While it is probable that the next developments in increasing the speed of trains will come gradually as in the past, it is of interest to calculate the cost in cents per passenger-mile of an increase in schedule speed to as high as 100 m.p.h. from a schedule speed of 40 m.p.h., for at such a high speed the train would be comparable to the airplane in speed. Assuming, therefore, an increase of schedule speed from 40 to 100 m.p.h., it is found from Fig. 6 that for a streamlined train the additional horsepower required ($P_{s2} - P_{s1}$) is 1,800. Assuming that for day-coach travel the average number of passengers per coach is 30, the cost of this additional speed to the passenger per mile can readily be figured from Equation [3] to be 0.2 cent. For sleeping-car passengers, the additional expense would be somewhat greater. This additional expense per passenger-mile is obviously so small compared with the advantages of high-speed travel that the railroads ought to be able to recover it many times over by the increased patronage of the public if the latter are offered this new mode of travel at little or perhaps no increase in fare. The rate for cross-country travel by airplane is at present (1931) about 6.5 cents per passenger-mile on a railway-mileage basis, with a schedule speed on the same mileage basis of usually from 100 to 120 m.p.h.

It is interesting, now, to find the capitalized value of the saving effected by streamlined trains over present-type trains for different schedule speeds up to 100 m.p.h. The life of an electric locomotive is variously estimated for depreciation purposes to be from 20 to 30 years. Taking an interest rate of 5 per cent for finding the present worth of an annuity, capitalization factors of 12.5 and 15.4 are, respectively, obtained for annuities running 20 and 30 years. Using these factors to capitalize the annual savings to be found from Equation [3] and Fig. 6, the curves of Fig. 7 are obtained. It should be noted that these are for the savings obtained by streamlining of the kind shown in Fig. 3, and hence do not take into account the savings possible by reducing the projected area of the trains by lowering the height of the trains. Neither do they take into account the savings possible by reducing the weight of the trains.

* * *



Union 50-yard dump car built in 1931 for the Differential Steel Car Company by Greenville

EDITORIALS

We Are One-Hundred Years Old

The turn of the year marks the one-hundredth birthday of the *Railway Mechanical Engineer.*

On January 2, 1832, when D. Kimball Minor, publisher of the daily New York American, issued the first number of the *American Rail-Road Journal,* he founded an institution which has served the railway industry through a century of marvelous progress and development. Its pages, and those of its successors, present a moving panorama of action—at times intensive, at times halting—by which an idea, still considered preposterous by the conservative at the time the publication was born, has been developed into the present smoothly functioning mass transportation system of America. As its pages are turned, the work of pioneer locomotive builders—Davis, Winans, Baldwin, Norris, Rogers, Mason—pass in review. In its columns are recorded the steps by which the steam locomotive has advanced from a sketchy machine, which frequently had to give way to horses when snow and ice clogged the rails, to the modern, reliable power plants of three and four thousand horsepower capacity. Later in the year we shall devote an issue to reminiscences of the *American Rail-Road Journal* and its successors and to a panorama of the significant events in the pioneer years of railway evolution.

Probably no single industry has played such an important part in the development of American civilization as the railroads. Speaking of a proposed railroad to connect Lake Erie with New York City by the southern tier of New York counties, the editor in the first issue of the *American Rail-Road Journal* presented the following picture of conditions when inland transportation depended on canals and navigable rivers: "It would prevent a recurrence of the state of things which now exists in this city (New York). There would not then be, as there now is, thousands of barrels of flour and other kinds of produce, in proportion, frozen up in canal barges and in sloops on the Hudson; salt would not be selling in Albany for two dollars and fifty cents per *bushel,* and pork at two dollars per *hundred* for want of salt to save it, whilst it is worth from five to seven dollars in this city. Coal would not then sell here for *fifteen* or *sixteen* dollars per ton, nor oak wood at *nine,* and hickory at *thirteen* dollars per cord, as has been the case for two or three weeks past, if rail-roads were in general use; but all kinds of business would move on regularly and be more nearly divided throughout the year. Produce could come to market as well in January as in July; and the farmer would not be obliged in order to get his crop to market in the fall to neglect preparing for the next." (The italics are in the original).

The settlement and development of a wilderness thousands of miles in extent in a single generation following the Civil War were made possible only by the pioneer activities of railroad builders. Today, in spite of the development of motor-truck transportation and a renewed interest in inland waterways, the material civilization of North America could scarcely survive a week were rail transportation to be completely suspended.

Competition of the motor truck is dangerous to the future integrity of railroad transportation only so long as it is maintained and developed on an unsound economic basis of government subsidies. All signs now indicate that the problem thus created will be solved by a public aroused to the full implications of the present situation and aware of the basic necessity for the maintenance of a healthy railway system.

Human affairs are never static. New conditions and new methods are constantly evolving. As the second century of transportation opens, the new possibilities which the co-ordination of rail, highway and water open up for American commerce and industry create a wide range of new problems, the solution of which will command the highest intelligence and initiative in the transportation field. The solution of some of these problems will fall within the jurisdiction of mechanical-department officers and supervisors. The *Railway Mechanical Engineer* faces the new era with confidence and with a determination to help its readers in meeting these new problems as they arise.

Modern Motive Power Produces Results

The results now being obtained with modern motive power constitutes a striking tribute not only to the locomotive designers and builders, but to railroad maintenance forces as well. Steam locomotives, in the days of assigned power, made, perhaps, 125 miles a day in freight service and twice that in passenger service, then being laid up an average of 12 to 16 hours in terminals until each crew was ready to make the next day's run. It may be said with certainty that many of these old locomotives, having inadequate boiler capacity, small tenders, bolted frames and cylinders, hand-adjusted wedges, inadequate lubricating systems, and probably carrying no auxiliary appliances to reduce unit fuel and water consumption and decrease the frequency of fuel and water stops, would find it impossible to meet the requirements of modern operating conditions. Modern passenger power now operates not 300, but 900 miles, or more, a trip, over many operating divisions, and the mileage of freight power has been increased in proportion. Mileages of 200,000, or more, are made between general repairs in the backshop, a performance which would have been considered impossible by motive-power officers not so many years ago.

Comparisons between the steam railroad industry and the automotive industry are frequently made to the disadvantage of the former, but, from the point of view of reliability and long mileage, steam railroad men need fear no comparison of the respective motive-power units. Consider the racing automobile, for example, driven by a special engine, designed, built and experimented with during an entire year, and often scrapped after a single race of 500 miles. Possibly one-third of the cars entering this race may not finish at all, but fail, due to overheating of the bearings, connecting-rod failures, etc. Five-hundred miles is only part of a day's work for a steam locomotive, however, which must produce results witb several different crews, burning widely varying grades of fuel and using all kinds of

water. Records of reliability of service, freedom from engine failures, and small percentage of locomotives with federal defects, even under present conditions of reduced maintenance, reflect the highest credit on modern motive power and the men who keep it in operating condition.

Training All Employees

Much attention has been given by the railway mechanical departments to shop apprentice training. Indeed, this training has been carried to a high state of development on a number of railroads, as a result of which the standards of shop craftsmanship have been raised to a relatively high level. The slowing up of business during the past two years has made it necessary greatly to reduce the number of apprentices and to shorten their working hours. This has presented a real handicap to the orderly carrying on of the training programs, but in most instances they have gone forward, even though on a reduced basis.

The past decade has witnessed the awakening of a realization as to the importance and necessity of training the foremen and supervisors better to deal with the human element under their control. It is significant that in many instances this urge for better training has come from the foremen and supervisors themselves. In most instances, also, this development has been on a more or less informal basis—that is, formal educational courses have been established in only a few cases; on the other hand, the problem has in many instances been tackled on a more informal basis by the organization of foremen's or supervisors' clubs. In some instances the railroad supervisors and foremen have joined with groups of foremen and executives from industry to study the broader principles of successful industrial management. Undoubtedly the training of the supervisors—formal or informal—has been a considerable factor in bringing about the better understandings between the men and the managements which have characterized the past few years.

Many changes have been made in the equipment and facilities of the railroads since the World War. In many instances this has made necessary a higher standard of skill and intelligence on the part of the worker, or, at any rate, it has been necessary to change shop maintenance and operating practices radically. It is to be feared, however, that too much has been taken for granted in assuming that the worker could readily adapt himself to these changes without special training. There is ample evidence, for instance, that some of the workers have been unable to adapt themselves to the new conditions. Incidentally, this applies not alone to the mechanical department, but is true of most of the other operations of the railroad. As a result, the sentiment seems to be growing rapidly that constructive measures should be taken, to the end that each employee will throughout his service life receive such training and coaching as is necessary to keep him abreast with the requirements of his particular task and also to fit him for promotion to larger responsibilities, if he is capable of assuming them.

This problem is not peculiar to the railroads, but applies also to all industrial and commercial organizations. The state and federal vocational departments have sensed the need of continuous training throughout the service life of the worker and this is true also of the industrial extension departments of state universities. These agencies, as a matter of fact, are ready and willing to help the railroads and other groups to the extent that their resources permit.

There is no question but that progress will continue to be made steadily on the railroads in improving the facilities and equipment better to meet transportation needs. This promises to bring about radical changes and improvements in equipment and facilities. It is vital, in the interests of efficiency and economy, that the workers be trained to give the best account of themselves in dealing with the new facilities as they are placed in service, and to maintain a high morale in the organization. The problem, then, of keeping all of the employees in the mechanical department "trained to the minute," is one that requires careful study, broad vision and statesmanlike handling.

Persistence Needed In Safety Efforts

It will be conceded that probably no other railway department has a greater responsibility for the prevention of all kinds of railway accidents than does the mechanical department. Not only must hazards incident to locomotive and car-maintenance work itself be minimized, but the kind of work done, as measured by the standard of equipment maintenance, has a most important bearing on accidents of all kinds encountered during the normal operation of this equipment in service on the line.

Regarding the mechanical department's responsibility for furnishing the kind of equipment needed for safe and dependable transportation, C. G. Goff, master mechanic, Southern, Birmingham, Ala., said at the October meeting of the National Safety Council in Chicago: "It may therefore, be readily seen that in the conduct of the activities of the mechanical department, there must be no failure of supervision or workmanship in the inspection, testing or preparation of equipment for service, and if the department is to discharge its responsibilities successfully, every one concerned, from the highest executive to the most common laborer, must realize and appreciate this fact, and failure either to assume or discharge this obligation and duty successfully cannot be overlooked or tolerated."

While accident-prevention efforts have been, in general, well organized and standardized in railway shops and terminals for a number of years, a critical analysis of injuries and accidents will frequently indicate that some of the primary or fundamental principles of accident prevention have not yet been learned, or else have been carelessly overlooked, even by veteran employees, some of whom have been in service ever since the idea of "Safety First" was first advanced about 25 years ago by Ralph Richards of the Chicago & North Western.

The mechanical requirements for safe work in and about railway shops and terminals are too widely known to justify detailed comment in this column, but even more important than mechanical safeguards and time-tested regulations is the creation of a desire for safety in the hearts and minds of shop executives, enthusiastically transmitted to and permeating the entire organization until it is shared by each employee. One of the best means of doing this is to encourage attendance at periodic safety meetings, at which suggestions for increased safety are advanced and either acted upon favorably or the impracticability of the suggestions ex-

plained. By no means should suggestions, even those of doubtful merit, be allowed to pass into the discard without comment. Complete harmony between supervisory officers and safety representatives is absolutely essential, all suggestions receiving not only careful but friendly and considerate attention.

In the effort to sustain interest in accident-prevention work, a number of roads conduct system-wide safety contests annually, awarding trophies to the departments, shops, or terminals making the best records in accident prevention. The good results accomplished by this method are illustrated on the Southern, for example, where Finley shop (Birmingham, Ala.) won the trophy in competition with other shops for the past two years, being honored by recognition and a certificate of commendation from the National Safety Council. While this shop established a record during the period from December 19, 1928, to February 19, 1931, of 6,802,859 man-hours without an injury reportable to the Interstate Commerce Commission the shop is now endeavoring to beat even this record—a worthy ambition, which other shops on this and other roads may hope, by persistent effort, to equal or exceed.

Manufacturing In Railway Shops

A correspondent on The Reader's Page of the December issue takes exception to our comment on the practice of manufacturing repair parts of various locomotive specialties in the railway shop. In his letter he presents a picture of some of the difficulties under which shop foremen have to work in times like the present when materials are scarce. He claims a fairly good job in the manufacture of these materials "even if the materials are not the same or workmanship not as fine." It is precisely this point which makes the practice unsound. Without the same materials and as fine workmanship as are embodied in the parts for many of these devices produced by their manufacturers, the reliability of the devices themselves is impaired. When it becomes necessary to replace three or four repair parts before one is found which will last long enough to let the locomotive get into service the problem ceases to be one of the price per piece. Such parts, produced for nothing, would be expensive when the delays to locomotives and the cost of installation are taken into account.

The whole question of manufacturing in railroad shops is a difficult one with which to deal in general terms. The justification for undertaking production of a particular piece of material for use in locomotive or car maintenance must be determined by the circumstances pertaining in the particular case. The production of certain rough materials may, in some cases, be justified by the fact that they offer an opportunity to utilize facilities which otherwise would remain idle. Unfortunately, however, the low costs which can be shown in such cases by the ability to ignore certain items of overhead are sometimes cited to justify the provision of additional facilities. It is undoubtedly this type of situation to which a correspondent, whose letter appears on another page in this issue, refers to as "an over expenditure of money in frozen property generally known as locomotive and car repair shops."

Whatever the merits of a particular project for manufacturing in railway shops may be, the danger of mistake is so great that no such project should ever be undertaken without a most searching investigation into all of the factors involved—not all of which pertain to relative costs—before any extension of the practice is permitted. In the case of highly developed parts involving the use of special materials and close tolerances for interchangeability, there is no chance of physical success unless the railroad is willing to make the same investment in experimental development and in special manufacturing facilities which the manufacturer has made—and then there will be no commercial advantage in competing with the manufacturer.

Retiring Freight Equipment

Many factors enter into the general subject of retiring freight equipment. Some of the more important are: Types of equipment required to meet traffic demands, service rendered by the cars in question as compared to that rendered by more modern equipment in use or available, and the cost to maintain or recondition. There is no standard practice with respect to retiring freight cars, largely because of the fact that the majority of railroads are required to care for considerable business the characteristics of which are peculiar to the individual road. However, those factors with which the mechanical department are most concerned have a number of essential characteristics which are common to all roads.

The "point system," which was described in the November, 1931, issue of the *Railway Mechanical Engineer*, page 525, was developed to insure a systematic selection of cars that have passed the stage where they can be repaired economically. It was first placed in effect on the Kansas City Southern and later adopted by the Delaware & Hudson, with certain revisions to suit its equipment.

The functioning of the point system, as described in the article, keeps in effect a definite method for determining the disposition of freight cars in need of extensive repairs, and makes obsolete the practice of checking a car and submitting a list of the material required to effect repairs. It is not necessary to "price out" the materials required and extend and total, which is often done in a somewhat hit-or-miss manner. Both labor and material costs are combined to give each point a value. Other costs can easily be included and undoubtedly are.

The simplicity of the point system, as used by the Kansas City Southern and the Delaware & Hudson, not only enables a foreman to make his estimates quickly and also to ascertain how various car parts are standing up in service, but it places the actual cost and accounting work in the proper department and in the hands of those who can do it best. The limit of points on cars in a particular series being fixed, a definite means is provided of preventing heavy expenditures on obsolete equipment when the condition of a car makes the layout of money unwarranted. The application of the point system in connection with an authorized retirement program assures the selection of the worst candidates for demolition. It eliminates selecting cars at random and wasting money by dismantling serviceable cars.

The points brought forward in favor of the point system as outlined in the preceding paragraphs are not ours, as much as they are the arguments which have been presented by the men who have been responsible for the successful functioning of this system of retire-

ments. Like every other system of this character designed for similar purpose, much of its success depends on the amount of revision done to adapt it to the special requirements of each railroad. This system, or any other, regardless of how well it is planned and developed, can be practically nullified unless the spirit and intent are adhered to. There are instances on record when excellent ideas and systems have been placed in effect for the apparent purpose of concealing the full import of the facts.

The fact that the value of a point can include overhead and other costs, in addition to the usual labor and material charges, is an important feature and should be given serious consideration by those who contemplate adopting a system of this kind. There is no doubt that such a system can play an important part in scrapping the obsolete which is costing too much money to maintain.

Keep the Cars Moving!

While great emphasis has been placed for a number of years on the necessity of keeping cars on the move, especially when loaded with revenue freight, this desirable objective was never more urgently needed than at present. Not only should the cars move, but at as high an average speed as possible, this being accomplished not so much by an increase in train speed as by the elimination of delays to loaded cars at terminals and en route due to defective mechanical conditions requiring that cars be cut out, emergency repairs made, or loads transferred. The responsibility for car conditions rests with the car department, although it must be admitted that the earnings of any given road, and, in a larger sense, the government-regulating bodies which control those earnings, are a most important factor.

Present conditions, in general, are not conducive to a standard of car maintenance which will permit greatly reducing terminal delays and thus improving railway net earnings and the quality of the service rendered. Regarding the elimination of terminal delays, E. J. Robertson, superintendent of the car department of the Soo Line, made the following statement in the course of an address before the Northwest Car Men's Association: "The ideal way would be to see that no car is loaded that is not in fit condition to carry its load to destination, barring unforeseen accidents, but with greatly-curtailed freight-car repair forces, it is practically impossible to do this; then again, if we attempted to put every car in condition to carry its load to destination, we would be criticized by foreign and private car owners on account of what they would claim was excessive charges for repairs." In other words, the conscientious car-department supervisor is more or less "between the devil and the deep blue sea," as regards keeping freight-car equipment in the kind of condition which he would like to see maintained.

Car men usually consider the problems of general railway management and especially government regulation as outside of their jurisdiction, and possibly understanding. They have a most vital and direct interest in these problems, however, and it is their direct responsibility so to marshal and present the facts regarding the condition of railway equipment to their respective managements that the adverse effect of inadequately-maintained freight-car equipment upon railway net earnings and prestige is never overlooked for a moment.

Railway car-department officers and forces will undoubtedly live up to their past reputation of striving to get the best possible results with the means available, conditioning equipment in so far as practicable for uninterrupted movement between initial and final inspection points of 500 miles or more apart and with a minimum of inspection at division points en route. Provision must be made for cutting inspection work itself to a minimum time consistent with checking fundamental car conditions, and the organization and facilities must be provided for promptly repairing any defects found, either in the train yard, without cutting out cars, or on adjacent repair tracks. A comparison of present railway operating methods with those of the past will indicate that much has been accomplished along this line until, now, almost any kind of running repairs can be performed in the transportation yard, often in less time than it takes to switch the cars out of the train, onto the repair track and back again. The provision of adequate mechanical facilities, organization and supplies necessary for the prompt handling of this work represents one of the most important contributions which the car departments can make to economy and improved railway service.

NEW BOOKS

THE CHEMICAL TECHNOLOGY OF STEAM-RAISING PLANT. *By Henry Norman Bassett, chief chemist, Egyptian State Railways. Published by Longmans Green & Co., New York. 240 pages, 5½ in. by 9 in. Price $5.*

In the search for efficiency in steam generation considerable research has been carried out on the effect of blending coals and its bearing on the fusibility of the ash, the properties of metals, and water sources and supplies in an effort to help solve problems of corrosion and failure in tubes and drums. Information relating to these various problems has been gathered from many sources and is presented in this book, the first three chapters of which deal with water supplies, filtration, water softening, and water treatment. Other chapters discuss at some length methods of preventing corrosion, the theory of combustion, indicators and recording instruments, boiler testing, furnace lining and boiler laggings, materials of construction, etc. The book has been written to help engineers in charge of boiler stations properly to appreciate the significance of the many chemical reactions taking place in their plants.

THE BALANCING OF MACHINERY. *By C. Norman Fletcher, A.M.I. Mech Eng. Published by Emmott & Co., Ltd., 28 Bedford Street, Strand, W.C. 2, London, England. 172 pages, illustrated. Price $2.40.*

The General Principles of Balance, Static Balancing Equipment, Dynamic Balancing Equipment, The Influence of Speed on the General Principles of Balance, Special Purpose Balancing Equipment, The Balancing of Reciprocating Masses and Complete Assemblies, and the Practical Correction of Unbalance are discussed in the nine chapters of this book. Mr. Fletcher considers the question of the balancing of machinery theoretically, dealing with each form of balance separately and then indicating how it may be examined and corrected, either individually or otherwise. The bodies concerned in the investigation are considered as being absolutely rigid. The book contains a complete description of the methods and machines used by the Great Western and the London, Midland & Scottish to balance locomotive driving wheels.

THE READER'S PAGE

Longer Life from Second-Hand Wheels

TO THE EDITOR:

The frequent references in recent issues of the *Railway Mechanical Engineer* to the subject of chill-worn wheels and the use of the A. R. A. wheel gage has led me to make the following suggestion.

Wheels condemned by the A. R. A. remount gage cannot be applied to foreign cars according to the provisions of Rule 82. This is not because the wheels are unsafe for further service, but on account of the fact that the car owner would not get full second-hand value for them.

Such wheels should be mated and stencilled "For use under system freight and roadway equipment." With this practice in effect, complete service life can be obtained from each wheel and thus save considerable money.

W. H. SHRIVER.

Air-Brake Catechism— Is This Better?

TO THE EDITOR:

Mr. Herndon's criticism of the question "What would be the result if the U-pipe were removed or leaking?", which appeared in the September, 1931, issue, page 465, is well taken.

May I propose the following question and answer as an improvement over that which was published?

Question.—What would be the result if the U-pipe were removed or leaking and the application-cylinder pipe and distributing-valve release pipes crossed at the distributing valve?

Answer.—With the independent brake valve in running position, a service application would not be effective. If there were a slow leak, the brake would gradually release. If the U-pipe were removed, it would be impossible to make a service application.

AIR BRAKE SUPERVISOR.

Too Much Investment In Shops

TO THE EDITOR:

I was much interested in an article appearing in your editorial pages in the November issue entitled "Expensive Economies." It was very forceful and should go home to at least 25 per cent of the railroad men who read it.

However, a gentleman comes back in the December issue with a reply which he disguises under the title "A Prophecy, A Promise or A Threat?", and proceeds to alibi himself and the railroads to death with an argument that won't hold water.

First off, he hits himself in back of the head with the statement that the railroad shops do include overhead but only for the time that the shop is open. He also uses the argument that the present condition of the railroads, or, in other words, the lack of funds, necessitates doing a certain amount of manufacturing in railroad shops, and, further, that the labor employed must be kept busy.

This all sounds very good, but if we will get right down to the bottom of this thing and bring the railroad men to realize that if in the beginning they had started with the right foot forward, these conditions would not exist today. I mean that the railroads of this country are suffering at the present time from an over-expenditure of money in frozen property, generally known as locomotive and car repair shops.

Aside from the millions of dollars invested in such property and real estate, depreciation and taxes on this property go on just the same, regardless of whether they are in use or not. This is an item of expense which the railroads should have shifted to the shoulders of the manufacturers. Had it been done, the author of the article in question would have no argument upon which to base his reaction to your editorial.

Further, every bolt, nut, or piece of material of any description manufactured or fabricated in a railroad shop by one man means, as near as it can be figured roughly, that about five men on the outside, employed by a manufacturer who makes this particular piece, the butcher, the baker and the candlestick-maker, are idle. If it were possible to make any sort of calculation, this would result in a sufficient reduction in traffic to the railroads to be noticeable.

Having spent several years in the employ of a railroad mechanical department, the writer is not deaf to the argument of the average railroad men that the locomotive and car shops are constituted to manufacture certain parts required. That is taught them from the time they begin their apprenticeship until they leave the service. Therein lies the first mistake. Had they, on the other hand, been taught that the business of the railroad is to transport passengers and freight, and that the shop was merely an evil necessity for the maintenance of equipment, and more time spent in securing business for the railroad rather than some means of making or manufacturing something cheap in order to deprive the manufacturer of the business, I am willing to swear that the railroads of today would probably not be facing the bugaboo of trucks and buses.

A READER.

* * *

Fifty-ton capacity steel box car built in 1931 by Magor Car Corporation for the Lehigh & New England

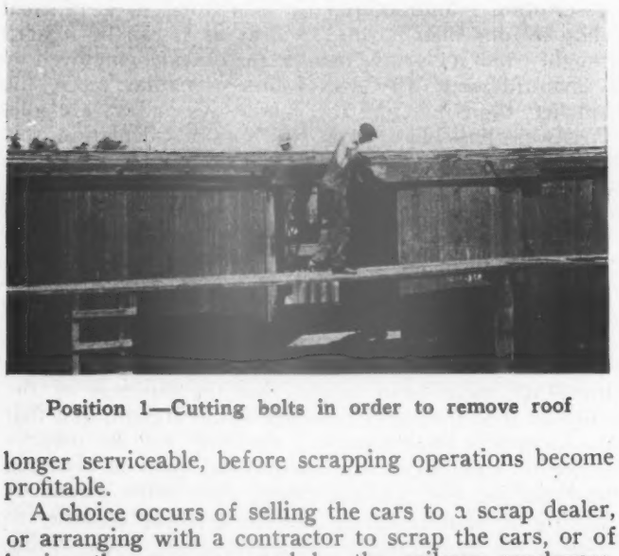
With the Car Foremen and Inspectors

Car Scrapping by the Line Production Method*

By T. M. Hamer†

THE following notes will cover some observations made in connection with car scrapping operations which occurred in 1931 in the middle west. No attempt is claimed for an exhaustive treatise of the subject.

The scrapping of obsolete rolling stock, at a time when car loading requirements have shown a considerable decrease, enables railways to liquidate a part of such investment which is not gainfully employed, and to provide employment for labor. It is noted that the primary cause of scrapping is obsolescence, and that the equipment need not be worn to the point where it is no longer serviceable, before scrapping operations become profitable.

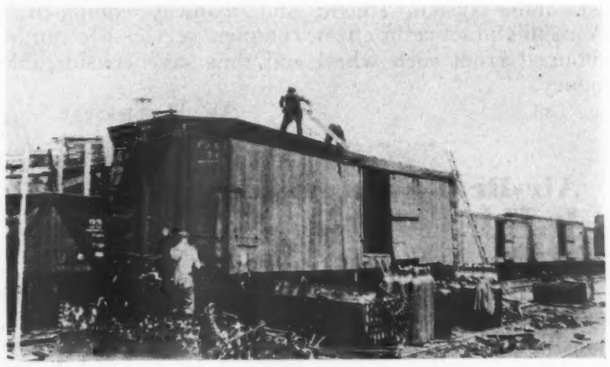


Position 1—Cutting bolts in order to remove roof

A choice occurs of selling the cars to a scrap dealer, or arranging with a contractor to scrap the cars, or of having the cars scrapped by the railway employees. Sometimes railway companies elect to sell their cars to scrap dealers specializing in work of this kind, and the railway company is relieved of this responsibility. On the other hand, the scrapping operations enable the railway to retain some of their employees who might otherwise be dismissed. By having the work done at various points on a railway, the money is spent in communities which are served by the railway, and this tends to bring more business to the railway than if employment decreases in such communities. A further advantage occurs sometimes in that the railway can economically reclaim or use various parts taken from the scrap pile.

In systematizing the demolition of railway cars, the line production method presents itself as logical. Instead of demolishing a car at one spot, the car is moved successively to a series of positions, at each of which one part or another of the car is removed or dismantled. A suitable yard track is set aside for this purpose, adjacent and parallel to a second track on which a travelling crane can operate to load the scrap, and with sufficient clearances to permit the unencumbered operation of the crane.

It is advantageous for the track to have such gradient as to permit the easy movement of cars from one position to the succeeding positions, without the assistance of a locomotive, and without undue exertion of labor. Yet the gradient should not be great enough to permit a car starting to move of its own accord, or to result in difficulty of stopping a car when it moves from one position to the next.



Position 3—Removing the roof

At the first position some part of the superstructure is removed, and parts of the car are removed or dismantled at each succeeding position, until the trucks only remain and finally only the wheels are rolled to the end of the track.

Following is an example of the set-up used in one case for scrapping wooden box cars, at the average rate of 16 cars per day.

Position No. 1—Cutting of bolts, nuts, and rods to permit the later removal of roof and sides. The average cuts were on about 170 ½-in. and ⅜-in. bolts and nuts and 12 cuts on 1¼-in. rods. Two cutting operations were used at this position, and the average consumption was one tank of 220-cu. ft. of oxygen for 9 cars, and one 250-cu. ft. tank of acetylene for 36 cars. Scaffolding

Position 6—Side-boards removed

* Read before the 32nd annual convention of the International Acetylene Association, Chicago, November 11 to 13, inclusive.

† Air Reduction Sales Company, New York.

was erected at this position for operators' convenience in cutting.

Position No. 2—Cutting of transom and draft bolts, involving an average of 10 1-in. rods, 200 ¾-in. bolts, 2 ⅞-in. rods, and 24 ⅝-in. bolts. Three cutting operators were used at this position, the average consumption being 10 cars per cylinder of oxygen and 50 cars per cylinder of acetylene.

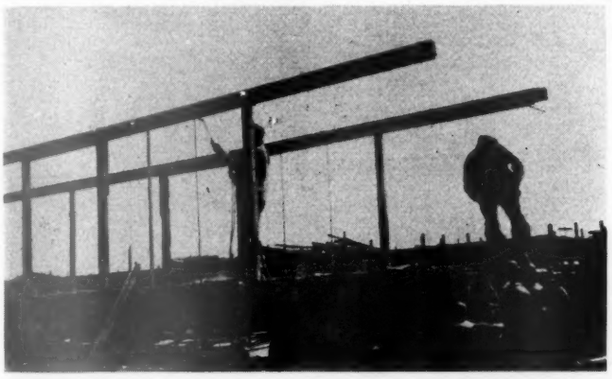
Position No. 3—Roof of car removed.

Position No. 4—All end lining of car removed.

Position No. 5—All side lining removed.

Position No. 6—Side boards removed. No cutting operators were required at positions 3, 4, 5, and 6.

Position No. 7—Removing superstructure framework: 56 cuts on ⅞-in. side-post rods, 28 cuts on ¾-in.



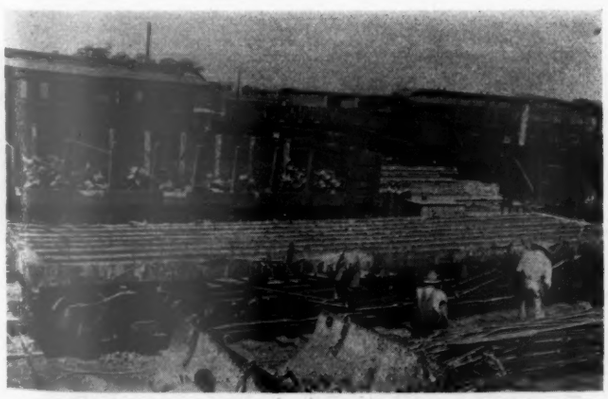
Position 7—Removing the framework of the superstructure

carline rods. One cutting operator was assigned to this position, using one cylinder of acetylene to 84 cars and one cylinder of oxygen to 14 cars.

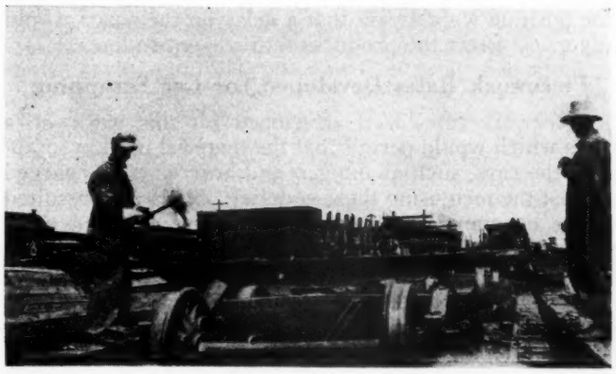
Position No. 8—Floor boards removed. No cutting operator was required at this position.

Position No. 9—Removing air-brake cylinder, draft arm, transom, and cutting underframe bolts, with an average of following cuts: 12 arms, 1¼-in.; 10 bolts, 1-in.; 86 bolts, ⅝-in.; 4 bolts, 1¼-in.; 16 bolts, 1½-in.; 8 bolts, ⅞-in.; 24 bolts, ¾-in. Two cutting operators were assigned to this position, using one cylinder of oxygen for 7 cars, and 1 cylinder of acetylene for 42 cars.

Position No. 10—One cutting operator, removing sills, cutting an average of 16 bolts, ¾-in. per car. Operator performed other work, as cutting was a very minor part of this position.



Position 9—Removing air-brake equipment



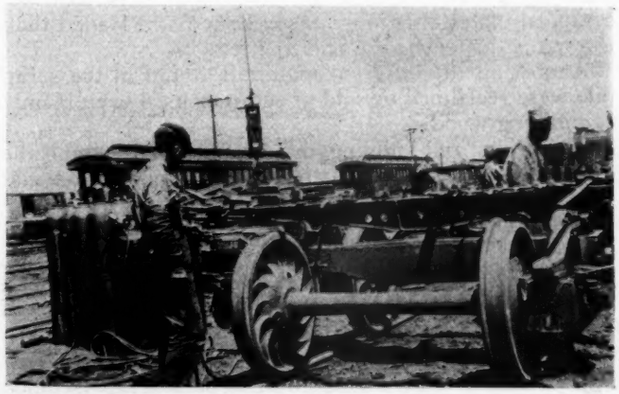
Position 11—Dismantling trucks

Position No. 11—Dismantling trucks, average cutting: 32 bolts, 1¼-in.; 32 bolts, 1-in.; 32 bolts, ¾-in.; 16 bolts, ⅝-in.; 26-in. of ½-in. thickness. One cutting operator was assigned to this position, using one cylinder of oxygen for nine cars, and one cylinder of acetylene for 56 cars.

Position No. 12—Cutting bolsters. One operator (cutting) was used at this position, using one cylinder of oxygen for 34 bolsters, and one cylinder of acetylene for 238 bolsters. After position No. 12, only the car wheels remained on the track.

It will be noted that 11 cutters were employed on the above line-up, for scrapping 16 cars per day, exclusive of other labor. These 11 men assisted on other work besides cutting, when opportunity occurred. Most of these 11 cutters had never used a cutting torch prior to this assignment, as they had been employed in departments involving actual train operation, and other work where the oxy-acetylene cutting process is not used.

Most of the crew had to receive their first instructions



Position 12—Cutting bolsters

in handling the cutting torch when they came on the job, and consequently the production of 16 cars per day was not achieved at the start.

However, 800 cars were scrapped in approximately ten weeks, and except for occasional or unavoidable delays and interruptions, the rate of 16 cars per day was achieved and maintained with comparative ease. At the rate of 16 cars scrapped during an 8-hour day, it is noted that the average length of time per car per position was 30 min. Since each car moved forward along the line each 30 min. the advantages of line production work became apparent in that the crew at each position was working against time, and the men at

one position were aware that a delay on their part would adversely affect the production of the entire line.

Piecework Rates Developed for Car Scrapping

Piecework rates were developed for this work, on a basis which would permit that the material used in scrapping the cars, such as oxygen and acetylene, be charged against the men using these supplies. This plan resulted in the economical use of material, just as piece work promotes the economical use of time. More careful thought was given to proper tip sizes, and gas pressures for cutting purposes, than is usually the case, in order to decrease gas consumption without increasing cutting time. The operators learned, of course, that tip sizes and gas pressures could not be reduced below a certain degree without unduly increasing the time element. The number and size of preheating jets on the cutting tip were not reduced below those normally used, because of the paint, rust, and dirt which would interfere with the cut if the preheat were unduly reduced. It was possible to convince the operators that high gas pressures are not necessary in the preheat mixture, and these were maintained at lower pressures than usual.

Some discussion developed as to whether it is best to reduce the oxygen cutting jet pressure, or the diameter of the orifice, in establishing economical practice. It was possible to use a smaller cutting jet orifice than generally has been used in car scrapping, making a narrower kerf, but the oxygen cutting jet pressure was not materially reduced, because the operators claimed they could not otherwise blow slag dust, etc., out of the path of the cut.

An advantage of the line production method occurs in that each operator can set his gas pressures at the most economical cutting for the position to which he is assigned, and does not require to change pressures or tips to get economical results, as would be the case if one operator did the cutting for an entire car.

Another advantage in the line method is that the scrapped material is more easily sorted and loaded than if a car is demolished in one position.

Almost all the different materials found in the scrap pile were reclaimed or sold as scrap or used even if only as kindling wood.

The bridge and building, maintenance of way, and the locomotive and car departments all found occasional uses for various parts of the scrap material.

An Efficient Incinerator

THE illustration shows the use of a scrap locomotive-type boiler for the economical disposal of refuse, garbage and miscellaneous scrap material at one of the largest passenger terminal yards in the country.

The boiler, which is of fairly large size, as indicated in the illustration, is upended on a concrete foundation, the firebox lined with firebrick and the upper half of it provided with a swinging door on a level with the substantial platform and inclined runway, up which the refuse and scrap materials are trucked. The lower half of the firebox is open, being reached by a concrete-paved runway for the removal of ashes and any material which will not burn and falls through the grates. The latter are constructed of iron crossbars, generously spaced. The top of the incinerator is carefully screened to prevent the emission of sparks. The brick sidewall, stayed with rods as shown in the illustration, is provided simply as a medium of insulation to prevent the scorching of varnish on any cars which may happen to be on the adjacent track.

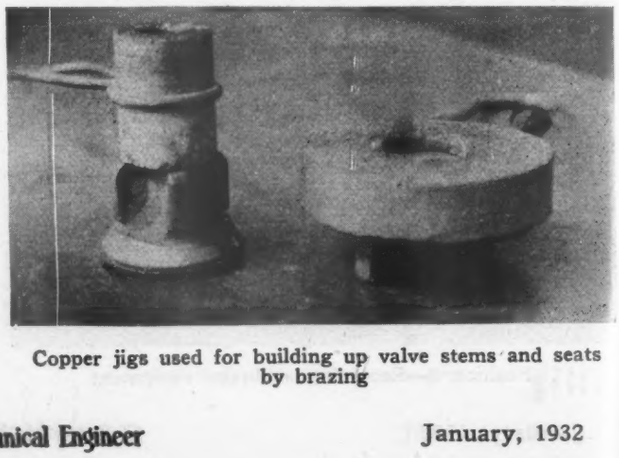
All the refuse material from railroad cars, as well as Pullman equipment, is burned in this incinerator, which, because of the strong draft and intense heat assured

Scrap locomotive boiler used as an incinerator for the disposal of refuse at a large passenger terminal yard

by the design, will quickly dry and burn almost any kind of scrap and refuse placed in it. Six laborers are employed to clean the yard and dump all refuse on the platform, from which one man feeds it to the incinerator, as required. This work does not require the entire time and attention of one man, however, and the incinerator attendant has other duties to perform.

The advantages of this incinerator, located where it is, may be summarized as the complete and ready disposal of passenger-car yard refuse at the point where it originates, thus saving a considerable expense and delay in hauling it away, as was formerly done. Car equipment used for this purpose is saved, as well as the transportation expense involved in moving it.

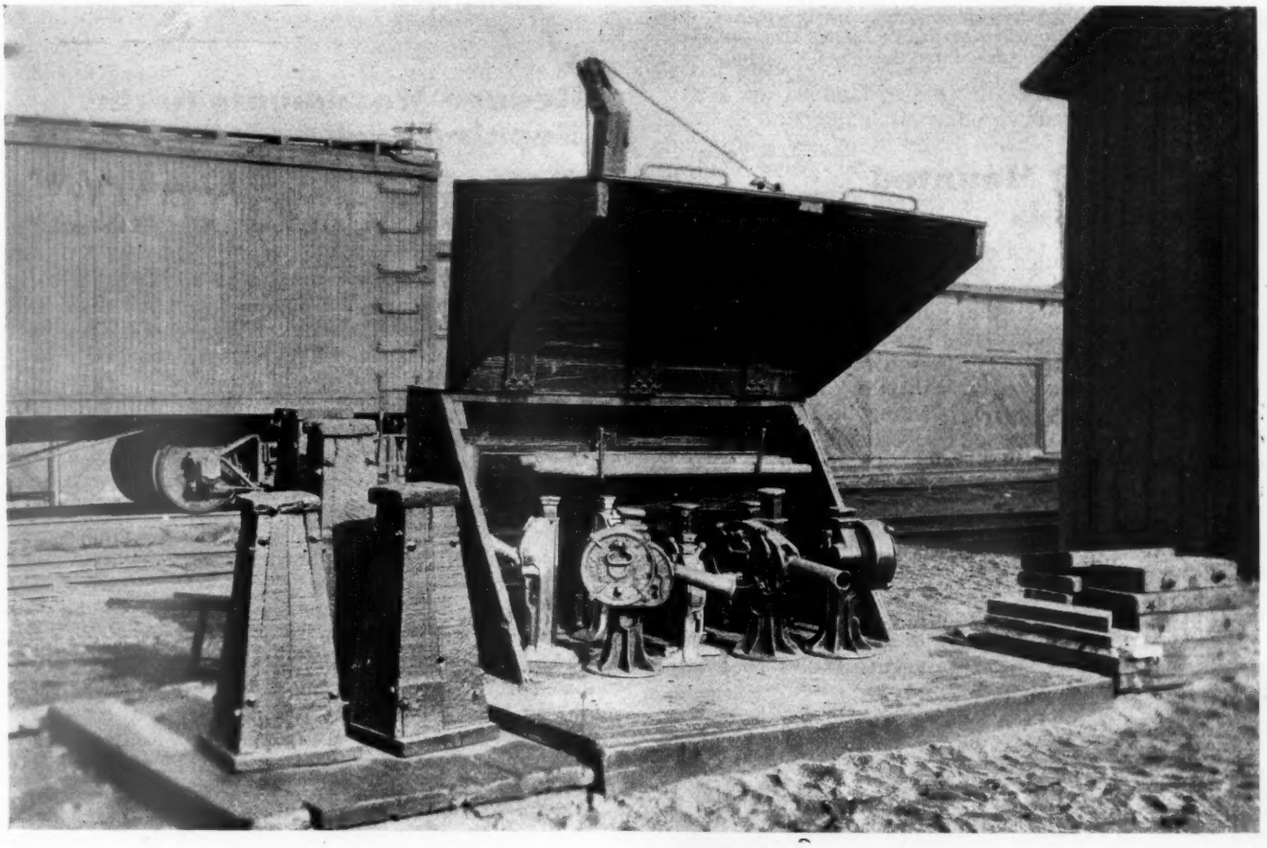
* * *



Copper jigs used for building up valve stems and seats by brazing

Protecting Car Jacks From the Weather

A PLACE for everything and everything in its place is the motto of many car foremen. However, this saying is particularly applicable to the car foreman who provides a shelter for his car-repair jacks, especially during the winter months. The illustration shows the manner in which car jacks, jack sticks, car trestles tnd blocking are cared for.



Car jacks last longer when they are protected from the weather

The front covering or door of the shed is hinged at the top and balanced with weights and can be raised with very little effort when the car repairman desires to obtain a jack. The top is covered with canvas which has been coated with a waterproof paint and affords ample protection from the weather.

Questions and Answers For Air-Brake Foreman

FOLLOWING is the sixth of a group of questions and answers selected from the instruction pamphlet recently revised by an eastern railroad:

Q.—What may cause brake-cylinder pressure to increase above the setting of the reducing valve with the independent brake valve in lap position? A.—Leak from main reservoir or of brake-pipe air into the application cylinder on account of defective distributing-valve gasket or automatic-brake-valve rotary.

Q.—What may cause brake-cylinder pressure to increase to the setting of the independent-brake reducing valve with the independent brake valve in lap position? A.—Defective independent-brake-valve rotary or seat.

Q.—What is indicated if the distributing valve vibrates or makes rumbling noises when the independent brake valve is placed in quick-application position? A.—Worn application piston guide, worn baffle piston or loose application-piston pin.

Q.—Explain why these defects are undesirable? A.—They may ultimately cause a broken exhaust valve or application piston.

Q.—What may cause brake-cylinder pressure to increase to the setting of the reducing valve after a partial straight-air application with the brake valve in lap position? A.—A leak through the straight-air brake valve.

Q.—When may it be known that the independent or straight-air-brake reducing valves are properly adjusted and brake-cylinder gage correct? A.—When 50 lb. brake-cylinder pressure is obtained when making a 20 lb. brake-pipe reduction from an initial brake-pipe pressure of not less than 70 lb., and 45 lb. brake-cylinder pressure is obtained with either the independent or straight-air brake fully applied.

Q.—When may the pressure registered by the brake-cylinder gage be accepted as correct brake-cylinder pressure. A.—When the brake-cylinder cutout cocks are open.

Q.—What should be noted after a 10-lb. service reduction is made when the automatic brake valve is moved to release, running or holding position, with the independent brake valve in lap position? A.—That the brakes do not release.

Q.—What should be noted with respect to the double-heading cock? A.—That it is operative.

Q.—How may it be known that the double-heading cock is operative? A.—By making a service reduction of 10 lb., closing the double-heading cock, then placing the automatic brake valve in running position, noting that the brake-pipe pressure does not increase until the double-heading cock is opened.

Q.—If a service reduction is made, double-heading cock closed and the brake valve is then placed in running position and double-heading cock then opened, what should take place? A.—The brakes should release.

Q.—If the brakes release after an automatic application with the independent valve in lap position, automatic brake valve in release, running or holding position, what defect may be present? A.—Defective distributing-valve gasket or leaking

safety valve, leaking distributing-valve release pipe, defective independent rotary valve or seat or lower gasket, and with No. 5 E T equipment, a leaking double-heading pipe between the double-chamber reservoir and double-heading cock.

Q.—What will indicate a leaking double-heading cock? A.—An increase of brake-pipe pressure after a service application, provided the double-heading cock is closed after the application is made.

Q.—What should be noted with respect to the independent and automatic brake valves? A.—That they move freely to all positions.

Q.—What may prevent the free movement of automatic brake valves? A.—Lack of lubrication of the rotary valve, rotary-valve keyway washer or handle latch; also, on electric locomotives, it may be caused by the handle binding in the handle guard.

Handling Mounted Car Wheels

WHEN mounted car wheels are loaded on flat cars for shipment from the wheel shop to outlying car-repair tracks they must be loaded in accordance with the A.R.A. loading rules or in such a manner as to make the load safe for movement over the railroad. If wheels are loaded on flat cars, the rules provide that 20 pieces of 4-in. by 8-in., blocking be fastened to the car floor on both sides of the outside wheels and in addition a clamp made from ¾-in. round iron must be used to clamp the three pairs of wheels together at each end of the car. This method of blocking is not only expensive, but if the cars are handled roughly in switching it usually results in damage to wheel flanges and journals making the wheels unfit for use when they arrive at their destination.

The accompanying photograph shows a flat car which has been equipped with permanent cradles so located as to prevent the wheels or journals from striking.

Four 2½-in., by 12-in., planks the length of the car are laid on the car floor. Crescents are cut in the planks 12 in. apart and a steel strap ¼-in. by 2½-in. is applied to conform to the crescents and run the entire length of the car. Bolts ¾ in. in diameter, passing through the steel strap, the 12-in. plank, the car floor and the nailing sill, secure the cradles to the car.

While it is possible that some question may arise as to the interchange of cars equipped in this manner, because no provision is made for loading wheels other than with temporary blocking and end clamps, there can be no objection to their use for the handling of company material on system lines and they will prove a valuable asset in eliminating wheel and journal damage and the costly operation of loading and blocking.

Reduce Movements to the Repair Track*

By H. L. Rice†

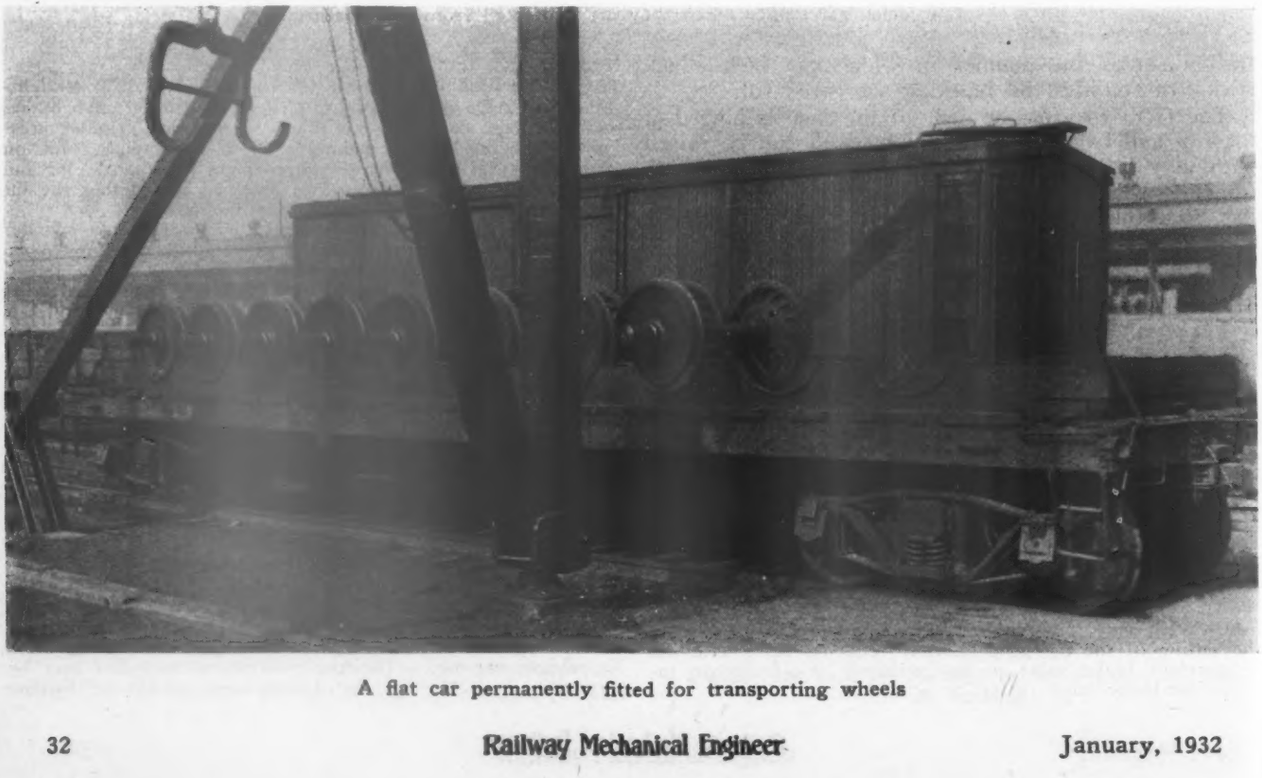
A. R. A. Rule 60 provides that air brakes must be cleaned annually; A. R. A. Rule 66 provides that journal boxes must be repacked annually. Nearly all railroads now have instructions providing that draft gears must be inspected annually. The average life of a cast iron wheel is around six years so that a car will have to be shopped for wheels about each year and a half. Brake rigging will wear out and other defects occur so that we can safely figure that a freight car will appear on the repair tracks about four times per year for the above mentioned items of repair.

We must also consider that there will be accidental damage, hot boxes and cut journals, repairs to make cars fit for commodity lading and other miscellaneous repairs which would ordinarily cause the cars to appear on the repair tracks additional times during a year's period. We can reasonably assume that these defects will contitute two repair track movements a year making a total of six expected repair track movements per year per car.

The problem which now confronts us is to cut down these expected repair track movements. To do this we

* A paper presented before the Indianapolis Car Inspector's Association, Indianapolis, Ind., November 2, 1931.

† Mr. Rice is general shop inspector of the New York, Chicago & St. Louis.



A flat car permanently fitted for transporting wheels

must begin when the car is in the shop for general periodic or heavy repairs. At this time the car should have the boxes repacked, air brakes cleaned, draft gears examined, all defective and worn parts repaired or renewed and the car made generally fit to run an entire year barring accidents or perhaps a shopping or two to make fit for commodity lading.

The car when next appearing on the repair tracks for annual work should have all work performed at the same time and the car stenciled accordingly reducing three trips to one trip. And we can go still further and make a general inspection of the car and renew any worn parts that might prevent the car from remaining off the repair track for another year.

Things will go wrong, however, and cars will get in trouble. We might have to change a triple and give the car another Rule 60 job before the year was out or perhaps repack the boxes or do any of the many things which might occur. Our uniform dates will now be out of line. The thing to do in this case is to make some more rules. For example: If a car is on the repair track for rule 60 and the date of repacking boxes or examining draft gear is more than six months old all of the work shall be performed and the car restencilled accordingly. And the same thing for any of the annual jobs. This will keep the car off the repair tracks for this work for another six months' period. And of course if the car is on the repair track for other work with the dates of annual jobs nine months old then these jobs should be cared for and save the later movements.

By handling the repair track movements and repairs when on the repair track as outlined above the total number of movements can be reduced to about three per year instead of six movements per year.

Examples of Improved Performance

And now for a little proof: In 1928 a series of double-sheathed box cars were being repaired on our line. The cars were receiving extensive repairs with a view of having eight years service life before another shopping for general repairs. Five of these cars were selected at random and the repair track movements on our line traced with a view of determining how many times they were shopped and for what reasons. We found that they were shopped for Rules 60 and 66, wheels, hot boxes, draft gear, adjusting coupler heights, air-brake repairs, accidents, and to fix up for high class commodity. These five cars were on our repair tracks over the period from the latter part of 1928 to September, 1931, an average of 1.48 times per year. We did not have them all every year for Rule 60 and since Jan. 1, 1930, for Rule 66. This work must have been performed on a foreign line and it amounts to an average of one time per year or a total of 2.48 times per year per car that the car was on the repair track for expected shoppings.

Another series of single sheathed box cars was repaired about the same time. A check-up of the movement of five of these cars, selected at random, showed a record of being on our repair tracks 2.47 times per year and on foreign repair tracks .78 times per year, or a total repair track movement of 3.25 times per year per car for expected shoppings.

A series of all-steel hoppers was repaired in 1929 and, based on the average of five random cars, shows a repair track movement of 1.76 times per year per car on our lines and .7 times on foreign lines or a total of 2.46 times per year per car for expected shoppings.

The three series of cars mentioned above received specialized general repairs.

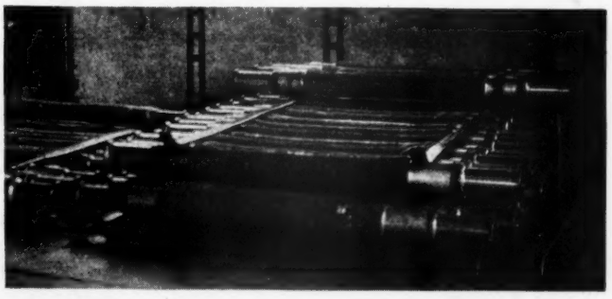
In the early part of 1928 we made repairs in kind to some double-sheathed box cars. On a five-car average basis these cars have been on the repair tracks 2.6 times per year and on foreign lines .73 times per year a total of 3.33 times per year per car for expected shoppings.

We started bearing down on the idea of having cars taken care of when on repair tracks in 1930 and the favorable results which we have had make us feel satisfied that we are on the right track. We think that in a couple more years we can show a still more favorable figure so far as cars repaired on foreign lines for expected work is concerned.

It is not claimed that we are the originators of this idea. I understand that the Pennsylvania has something quite similar in effect which is working satisfactorily. Some other roads have recently adopted the idea and are at the present time placing it in effect. At any rate if we can take care of our equipment properly when it is on the repair tracks, and we certainly can do that, we will be able to keep the cars off the repair tracks 50 per cent of the time that most of them are now on, cut down complaints from shippers because of the delays and make the work of all concerned easier.

Storing Car Axles Safely

A METHOD of storing car axles, which is both a simple and an effective measure, is employed at the Milwaukee (Wis.) freight-car shops of the Chicago, Milwaukee, St. Paul & Pacific. Steel strips of the proper length are simply bent upward slightly at the ends



Storing of car axles by means of steel strips with turned-up ends

and serve to support one layer of axles on top of another. The turned-up ends prevent the possibility of the axles rolling off the pile and possibly causing a serious accident. This method has obvious advantages over the use of wooden strips and blocking which may slip out of place. The illustration is printed through the courtesy of the Milwaukee Magazine.

ONE OF THE STORIES they tell about William P. Kenney, who became president of the Great Northern on January 1, runs like this: It was in 1904. Mr. Kenney, then chief clerk in the freight department, had no reason to believe that he was known at all by James J. Hill, who was then president of the Great Northern. One day he was summoned to the president's office. Mr. Hill had a visitor—a man who operated a granite quarry at St. Cloud, Minn. Mr. Hill explained that this man could get a big order from a Chicago contractor, if he could get a 14-cent rate on stone. In spite of the intricacy and complexity of the freight rate structure, Mr. Kenney was able to explain at once how a 14-cent rate could be obtained. The visitor was skeptical, but Mr. Hill interposed, "Well, if Kenney quotes a 14-cent rate, you can bet it's in." And, of course, it was.

In the Back Shop and Enginehouse

Gas Welding on the Nickel Plate*

By J. C. Miller†

IN the past when it was necessary to weld a broken frame considerable expense resulted from removing the frame from the locomotive and reapplying it after the blacksmith weld had been made. Contrast this procedure with the present day gas welding method of repairing broken frames. In this process it is only necessary to remove the parts adjacent to the fracture. The material on each side of the fracture is removed by the use of the acetylene cutting torch, the cut being made in the shape of a "V" from both sides. The new surface thus presented is cleaned by the use of either a pneumatic chisel or the sand blast process. The next operation is securing the desired expansion which of course, depends on the size of the frame. This is accomplished by the use of a small powerful jack developed in our local shops. The last operation prior to the actual welding operation is placing a plate on the bottom side of the section to be welded in order to give a foundation for starting the weld.

In the actual welding operation two torches are employed, the operators working opposite one another. When the weld is made with steel the operators must be careful to have the ends of the fractured frame at a temperature which will permit the puddling in of the steel welding rod. When bronze is employed in making the weld the temperature of the frame ends must be such that the bronze will adhere properly—about 1,600 deg. F. The success of the weld depends on the experience and judgment of the operators. While we have no definite data on the cost of removing a frame from our modern class of power, we have every reason to say conservatively that a saving of 90 to 95 per cent is effected by gas welding.

While we did use steel rod when making frame welds in the past, we have for several years been using Tobin bronze. The reason for this material being adopted lies in the fact that there is a considerable time saving effected as compared with the use of steel welding rod. Since the use of Tobin bronze was inaugurated there has not been a single case of the bronze weld breaking.

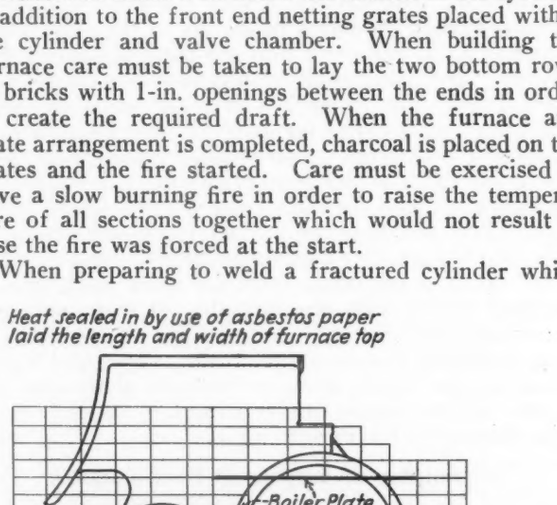
The next gas welding process of major importance at our shops is the welding of broken cylinders. This operation may be divided into two classes, with sub-divisions as shown in the table.

In all the cases referred to above the cylinders are preheated, the extent of which, however, depends on the nature of the fracture to be repaired.

Method of Pre-Heating Employed

When building up defective cylinder- or valve-chamber-head joints the preheating may be accomplished by placing a grate of front-end netting half way up from the bottom of the cylinder of valve chamber and building a charcoal fire thereon. The outside of the cylinder must be covered with heavy asbestos paper to retain the heat developed and to prevent cold air from coming into contact with the heated cylinders. The balance of the various classes of fractures, in our opinion, should always have a brick furnace built around the cylinder. In this case a grate of front end netting is placed across the furnace wall about 6 in. below the bottom of the cylinder in addition to the front end netting grates placed within the cylinder and valve chamber. When building the furnace care must be taken to lay the two bottom rows of bricks with 1-in. openings between the ends in order to create the required draft. When the furnace and grate arrangement is completed, charcoal is placed on the grates and the fire started. Care must be exercised to have a slow burning fire in order to raise the temperature of all sections together which would not result in case the fire was forced at the start.

When preparing to weld a fractured cylinder which has not been removed from the locomotive and which has a brick furnace built around it, we find it is a very good rule not to start the welding until the cylinder saddle adjacent to the flange has reached a temperature which will not permit the hand to be placed comfortably thereon.


Heat sealed in by use of asbestos paper laid the length and width of furnace top
Boiler Plate Forming Door
Air Passage
Grates made of front end netting
Air Passage
Ground Line
Side and back walls are bricked up solid with the exception of the second row from bottom which should have four air passages on sides and three in the rear wall
Doors to be made of boiler plate

Welding furnace

In the case of the welding of a cylinder fracture when the cylinder has been removed from the frame the furnace is built entirely around the cylinder. The grate arrangement is the same as previously described. The top of the furnace around the cylinder is covered with several layers of heavy asbestos paper.

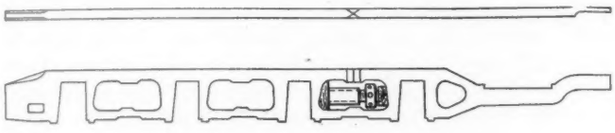
In the construction of furnaces around the cylinders it must be thoroughly understood that the construction be such as to permit easy removal of sections to afford access to the fracture. At the point above the base of the furnace where begins the section of brick which it is desired to remove, a strip of sheet iron is placed on top of the bricks. The furnace sides are continued upwards, leaving an opening of sufficient width to permit access to the fracture. When the desired height of

* Read before the 32nd annual convention of the International Acetylene Association, Chicago, November 11 to 13, inclusive.

† Mr. Miller is superintendent of shops of the New York, Chicago & St. Louis at Conneaut, Ohio.

opening is reached a strip of heavy metal is placed on top of the bricks to support the upper rows of bricks used in completing the furnace. The opening thus provided is then bricked in with bricks laid with straight joints which permit easy removal.

While the welding is performed it is necessary to replenish the fire from time to time as the occasion may demand in order to maintain the desired temperature. When the weld has been completed the furnace must



Frame jacked for welding

again be fired up and completely covered with asbestos paper and allowed to cool to room temperature before the asbestos paper and brick are removed.

Bronze Welding Used on Cylinder Head Joints

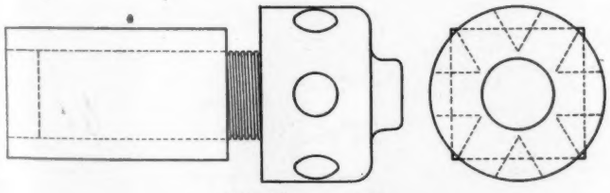
When building up cylinder of valve chamber head joints it is our practice to use bronze. Likewise when building up oversize stud holes prior to drilling and tapping to standard. The balance of cylinder fractures, with one exception, are welded with cast iron. The one exception is the case where the portion of the cylinder which rests on the frame rail has been so badly broken that it is necessary to replace the broken pieces with a piece of steel plate. In this case bronze is used as the

Subdivisions of Locomotive Cylinder Welding

CYLINDERS NOT REMOVED FROM THE FRAMES
Front of cylinders damaged by water blow
Cylinders and valve chambers cracked longitudinally
Valve chambers cracked circumferentially
Cylinder and valve-head joints built up
Oversize cylinder and valve chamber studs welded up
CYLINDERS REMOVED FROM FRAMES
Cylinders cracked in saddle
Cylinders cracked in frame fit

cast-iron welding rod would not make a satisfactory bond between the steel plate and the cast iron.

When repairing fractured cylinders with either bronze or cast iron we have never had a failure since we adopted gas welding on cylinder reclamation. We believe the secret of our success lies in the care we exercise



The frame jack

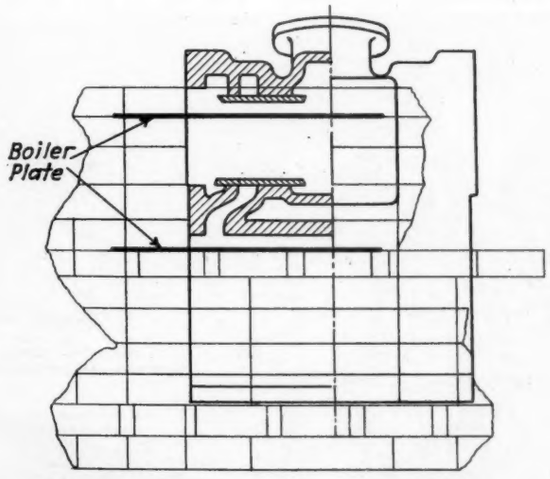
in the preparatory work. Of course, we appreciate that it is necessary to have experienced, skillful operators and, last but not least, good material.

Considering the saving effected by the gas welding process I will say that carefully compiled reclamation costs on a pair of cylinders removed from the engine showed that the cost of reclamation was only 25 per cent of the cost of new cylinders. It might be interesting to know that this work was performed about three years ago and that no trouble whatever has been experienced with the cylinders to date. Cylinder reclamation, in the case where the cylinders were not removed, can be accomplished for approximately 10 per cent of the cost of new cylinders. However, it must be thoroughly understood that the nature of the fracture governs the reclamation cost. Cases may arise where the nature of the fracture is so serious as to result in a heavy reclamation expense. The determining factor as to whether or not the cylinders must be removed is the location of the fracture.

Another major operation consists in building up worn sides of guides. It is one of our shop practices to maintain the dimension of our guides standard. When removed from the engines the guides are first straightened. They are then freed from all scale and foreign matter in order that they have a clean surface. In the building up process one operator preheats the guide, working just ahead of the second operator who applies the manganese bronze. Manganese bronze is used in this case on account of its wear-resisting properties which would not be the case if Tobin bronze is used. With the aid of this process we are able to build up a set of four guides in approximately two hours. Contrast this time interval, if you will with the old practice of patch bolting strips of metal to the sides of guides which required approximately twenty hours to one set of four guides.

Method of Building Up Wearing Surfaces

We also maintain our motion-work parts standard so far as lateral is concerned by the application of manganese bronze to the wearing surfaces. In the past the



Method of bricking cylinder to weld web

worn end of the part fitting into the clevis was made sufficiently thick by blacksmith welding a piece on each side and machining so that the lateral motion in the clevis was thus taken up. We know that it is 60 to 75 per cent more economical to build up both the clevis and the part fitting into it by gas welding and then machining both to standard dimensions.

Stoker screws wear rapidly when in use and often have to have the flights built up to standard dimensions in order that they can properly transfer the coal. Some time ago a brand of welding rod was furnished which may be applied either by gas welding or the electric arc. This welding rod when applied presents such a hard surface that it cannot be machined. We found that when this rod was applied with the electric arc our operators could not produce a smooth surface which made it necessary to grind the outside edges of the flight. We then investigated the possibilities of applying the rod with the aid of the acetylene torch. It was found that our operators could produce a welded surface which re-

quired no grinding. While we do not know the length of life we may obtain we know that the service already obtained is such that the additional cost of applying the rod with the acetylene torch as compared with the electric arc is, at least, offset.

Just how much longer this conveyor screw will function remains to be seen but at the last shopping there were no appreciable signs of wear.

Repair Stand for 8 1/2-in. Compressors

By E. G. Jones

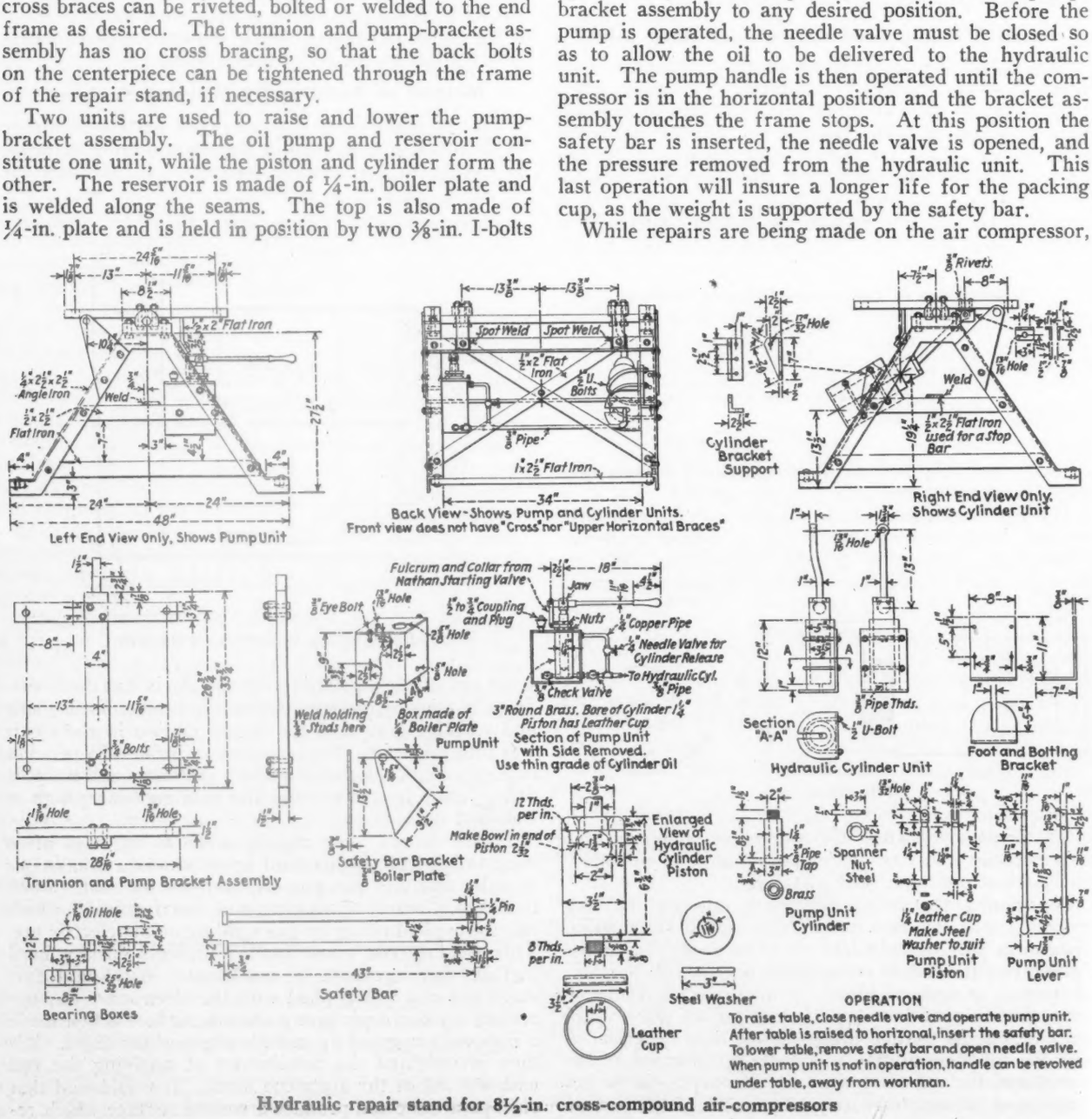
THE hydraulically operated repair stand for 8½-in. cross-compound Westinghouse air compressors is made of angle and flat iron to secure the greatest strength with the least amount of weight. The cross braces can be riveted, bolted or welded to the end frame as desired. The trunnion and pump-bracket assembly has no cross bracing, so that the back bolts on the centerpiece can be tightened through the frame of the repair stand, if necessary.

Two units are used to raise and lower the pump-bracket assembly. The oil pump and reservoir constitute one unit, while the piston and cylinder form the other. The reservoir is made of ¼-in. boiler plate and is welded along the seams. The top is also made of ¼-in. plate and is held in position by two ⅜-in. I-bolts placed as shown. The oil-pump cylinder is of 3-in. round brass with a 1¼-in. bore. The pump piston is of steel and has a leather packing cup with a suitable washer and nut.

To place a compressor on the repair stand it is necessary to use an overhead crane or similar lifting device. After the compressor is placed in position, it is bolted to the pump-bracket assembly. While in this vertical position the top centerpiece gasket is tested for durability across the steam ports by plugging the port holes at the centerpiece with pin grease and filling one port with water. If the water diminishes, the gasket is blown; if not, it is good and can be used again. It is then necessary to place the compressor in a horizontal position to fit rings, pistons, rod packing, and make repairs.

The compressor is easily brought to the horizontal position by the hand pump, which transfers the signal oil, or any other light oil, from the oil reservoir to the hydraulic cylinder and piston, which raises the pump-bracket assembly to any desired position. Before the pump is operated, the needle valve must be closed so as to allow the oil to be delivered to the hydraulic unit. The pump handle is then operated until the compressor is in the horizontal position and the bracket assembly touches the frame stops. At this position the safety bar is inserted, the needle valve is opened, and the pressure removed from the hydraulic unit. This last operation will insure a longer life for the packing cup, as the weight is supported by the safety bar.

While repairs are being made on the air compressor,


Left End View Only, Shows Pump Unit
Back View - Shows Pump and Cylinder Units. Front view does not have "Cross" nor "Upper Horizontal Braces"
Right End View Only. Shows Cylinder Unit
Trunnion and Pump Bracket Assembly
Safety Bar Bracket
Pump Unit
Section of Pump Unit with Side Removed. Use thin grade of Cylinder Oil
Hydraulic Cylinder Unit
Foot and Bolting Bracket
Bearing Boxes
Safety Bar
Enlarged View of Hydraulic Cylinder Piston
Pump Unit Cylinder
Pump Unit Piston
Pump Unit Lever
Steel Washer
Leather Cup
OPERATION
To raise table, close needle valve and operate pump unit. After table is raised to horizonal, insert the safety bar. To lower table, remove safety bar and open needle valve. When pump unit is not in operation, handle can be revolved under table, away from workman.

Hydraulic repair stand for 8½-in. cross-compound air-compressors

the pump handle can be revolved under the stand so as not to interfere with the repairman.

To lower the compressor the needle valve must be closed and the pump lever operated a few times to remove the weight from the safety bar. At this point the safety bar is removed and the needle valve is opened. The air compressor is pushed slightly to start it downward and the speed is then regulated by the needle valve which allows the oil to escape from the hydraulic cylinder to the storage reservoir. This needle valve is the same type used on Franklin air-operated locomotive fire doors for regulating purposes.

The piston in the hydraulic unit is of sufficient length to eliminate the installation of a crosshead, and so it will not injure the packing-leather cup by side thrusts encountered while raising or lowering the pump. The connecting rod is fastened to the piston by a ball joint and nut. This is the most desirable means inasmuch as it eliminates the necessity for absolute alinement of the cylinder with the stand.

This type of hydraulic repair stand is superior to the type which requires compressed air for its operation. Its location may be changed as desired, maintained in any position indefinitely, and does not require a branch air line. On the hydraulic stand the piping is in short lengths and is a part of the stand, being fastened to it. It depends on no outside power except that which is furnished by the small hand pump.

It is safer than an air-operated stand. There have been some badly mangled hands caused by the accidental opening of air valves on air-operated repair stands. The operator of the hydraulic repair stand is in no danger. It requires little effort to raise an 8½-in. cross-compound air compressor and is considered to be the most convenient stand in our air brake department.

Duplicating Wheel Flanges With Plaster of Paris

FREQUENTLY derailments occur at points where facing switch points are found to be slightly open or where the switch point is somewhat blunt. The engineering department will claim that the switch point

"Negative" and "positive" casts of wheel flanges will permit accurate gaging without shipping the wheels

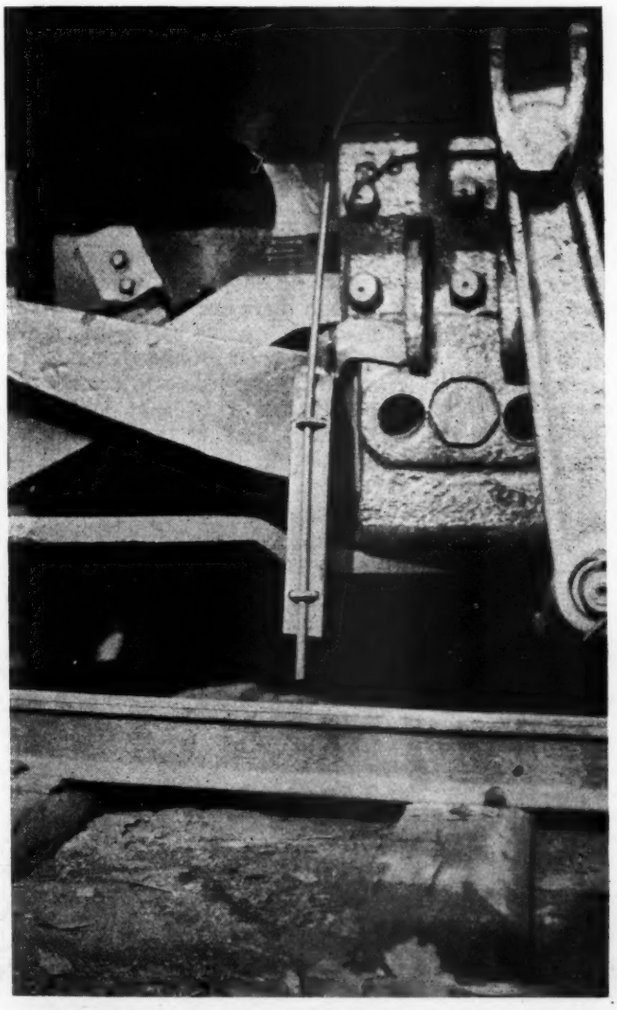
is not defective to the extent that it will cause a derailment unless the wheel flange is worn sharp. The mechanical department will maintain that the wheel flange is not condemned by the A.R.A wheel-defect gage and therefore is not defective. An impression is then made of the wheel flange and it is shipped to the test department where it is finally decided what actually caused the derailment.

When impressions are made of wheel flanges with Plaster of Paris the first cast cannot be gaged with any degree of certainty. However if the first impression is thoroughly covered with a coating of heavy oil, another impression can be made from it that will reproduce the original contours of the flange and enable anyone to determine whether or not the flange is condemnable by the A.R.A. wheel defect gage without the necessity of shipping the questionable wheel. After the Plaster-of-Paris impression dries sufficiently the gage can be placed on it in the same manner as it is placed on a wheel and the decision reached without difficulty.

The illustration shows a first and second impression of a wheel flange that "almost" took the condemning limit gage.

Direct Steam For Washing Rails and Drivers

AN effective method of washing sand from the rails and from the wheel flanges of locomotives has been in use for some time on an eastern railroad. A ½-in. three-way valve is connected to the back boiler sheet on the engineman's side, inside of the cab. The exhaust end of the valve is bushed down to ⅜ in. and copper tubing of that size is extended through the cab floor, under the ash pan and ahead to a point between the



The steam pipe is located back of the rear drivers

rear drivers and the trailer or booster truck. A pipe tee is located exactly at the center below the boiler and a section of tubing led off to each side and down to a point 2½ in. from the top of the rail.

Before starting to use sand, the engineman cracks the valve in the cab and live steam from the boiler washes the sand from the rail. Although tests are still being made with this arrangement with the steam directed on the wheel flanges immediately under the brake shoes, it appears to be working satisfactorily and washes the sand from the treads and flanges before it comes in contact with the shoes.

The illustration shows the location of the tubing for washing the rails.

(NOTE—This should answer the question raised by "General Superintendent" in the November issue of *Railway Mechanical Engineer*—EDITOR.)

A Portable Floor Crane

By Air Brake Foreman

IN all shops there is considerable work for a crane and where overhead cranes serve the shop there are some instances where such a crane can not serve some machines because of their location. At other times, where a lathe is to be overhauled and a crane is required for helping this operation, it would necessarily tie up the crane service to other parts of the shop. In automobile garages considerable lifting is also required and this type of crane is ideal, for it can be easily rolled to the cars. In the air-brake department it can be used for moving air compressors from the floor to the repair stands and back to the floor again. Thus no time is lost waiting for the overhead crane.

On account of its design it can be placed straddle a lathe and assist in chucking heavy work. There are numerous jobs in a machine shop where this portable crane is useful even though there are overhead traveling cranes. A load of 1,800 lb. can be safely lifted with this crane and carried to any part of the shop.

The frame is of angle and flat iron and riveted with ½-in. rivets. It can be bolted with ½-in. bolts, if so desired. A spacing block is used at the two top corners to insure correct spacing for the carriage. The carriage is made of ¼-in. boiler plate for the frame, and old dynamo ball-bearing races, complete, are used for the rollers. This frame is also spaced by pieces of pipe properly cut, as shown in the drawing, and held in position by inserting the studs through the pipe and tightening the nuts on the two upper studs, and by the insertion of the pin on the lower pipe and holding it in position by cotter pins. This type of carriage is cheaply manufactured and is easily operated. However, a more substantial carriage may be made by turning shoulders on the stud and pin, thereby eliminating the use of pipe spacers.

The casters are made by using the old balls and races of a Norton 35-ton jack. A steel bushing is pressed in the large holes and bushed down to ⅝-in. to allow the application of a ⅝-in. bolt for holding the two plates together. A caster frame is spot welded to the lower race plate. It is made of ½-in. boiler plate, as shown in the drawing. The caster roller is made of an old Moon dynamo ball-bearing race, over which is pressed a steel band to serve as a tire and prevent digging in on a wood floor. The crane frame is spot welded to this caster assembly, as shown in the drawing.

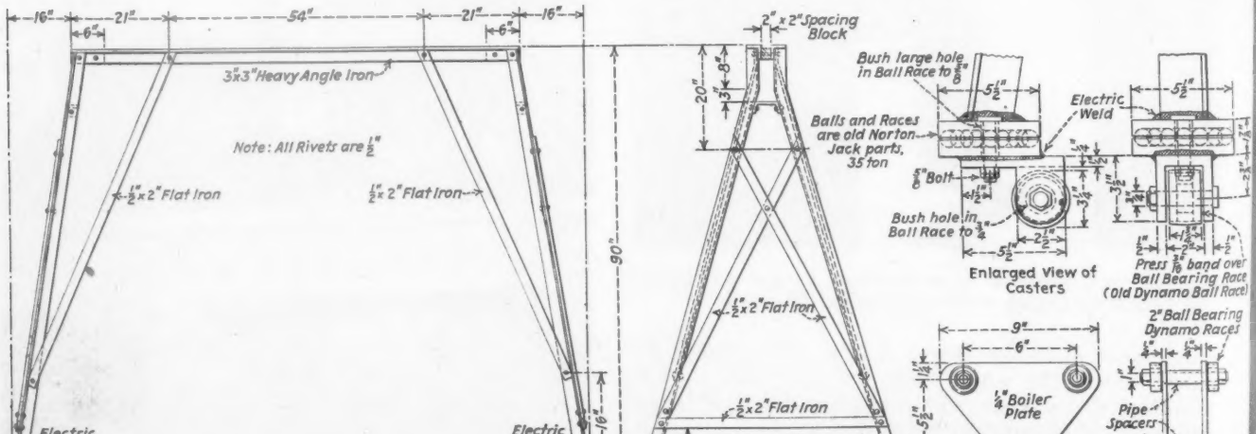
Care should be exercised in applying the ¾-in. bolt to the caster roller to allow the roller to revolve about the ball bearings. If the fit is too loose, the revolving moment will be about the bolt and the best results will be lost. Care should also be given to the spot welding so that the ball bearings will be free after the welding operation and not stick to the race plates.

This portable crane is easily operated and is a time-saver in all departments of a shop.

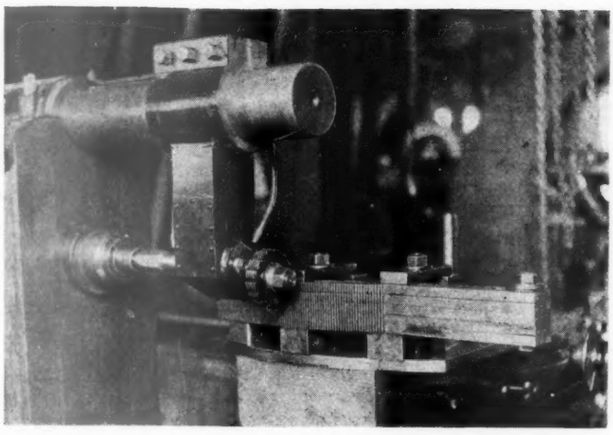
Making Throttle and Reverse-Lever Quadrants

AN efficient method of making throttle-lever and reverse-lever quadrants is now being followed at the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific, one of the features being the use of the knee-type milling machine set-up illustrated for milling the teeth.

In the case of throttle-lever quadrants, they are made of bar stock of the proper cross section and length, heated and bent on one end to give the required degree of curvature. The quadrants are then ground on each



Portable floor crane designed to supplement overhead and jib crane service

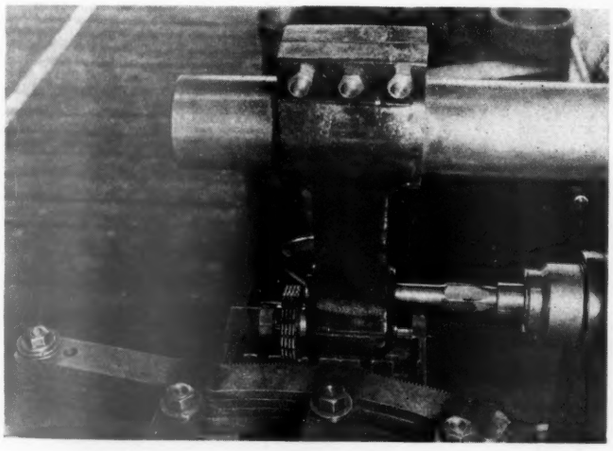


Cutting throttle lever quadrant teeth on a knee-type milling machine

side on a horizontal grinding machine, drilled and clamped together in groups of five to eight for machining the teeth.

Referring to the illustrations, the set-up on the knee-type milling machine will be readily understood. The quadrants are simply clamped on a plate secured to the rotary table of the milling machine at the required distance from the milling cutter to give the correct quadrant radius. The special high-speed cutter is driven from the milling-machine spindle with an outward support to give necessary rigidity.

Operation of the cutter in conjunction with the vertical feed of the milling machine table not only forms



The cutter drive and supporting arrangement

the teeth but faces the tops of the teeth to give a uniform machine finish. Four teeth are cut at one time, the milling-machine table and holding fixture being rotated as required until all of the throttle-lever quadrant teeth are cut.

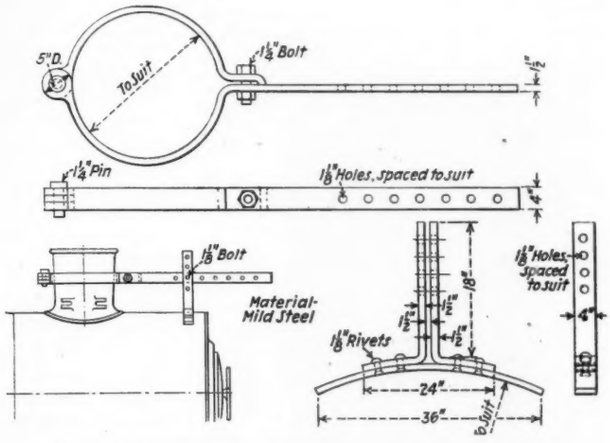
The teeth on reverse-lever quadrants are machined in a similar manner, the quadrants in this case being made from bar stock of the required cross section, rolled to the correct radius.

IT MAY KEEP THEM AWAKE AT NIGHT.—Coffee of an inferior grade, compressed into bricks, will be tried out as fuel on the locomotives of the government-owned Central Railroad of Brazil. Brazil is having a hard time disposing of low-grade stocks of coffee and the Minister of Public Works has authorized its use in locomotives in order to avoid having to dump the surplus into the ocean.

Device for Removing Front Ends

By H. E. Tracy

IN small shops where crane facilities are not available difficulty is often encountered in removing front ends due to the lack of a place for properly securing a chain block. This difficulty is overcome, and the removal and application of front ends is facilitated by



A chain-block support arrangement for removing locomotive front ends

the use of the device shown in the drawing. It consists of a clamp and a support, both made of 1½-in. by 4-in. bar steel.

The diameter of the clamp is made to suit the size of the stack and the length to suit the distance from the center line of the stack to the front of the smokebox. The support should be placed as near to the front end of the smokebox as possible to prevent undue stress on the clamp bar.

ANOTHER "PLUG" PASSES—One of the institutions of railroading is gradually fading out of the picture. It is the type of local passenger train which starts from one division point at an early hour in the morning and meanders down the line, stopping at all stations and eventually winding up at the next division point. Every railroad has had one or more. These trains have no fancy names and no fancy equipment; but, known in every village they pass as the "plug," they have been one of the best and affectionately-known railroad institutions. It is a matter of regret, therefore, that the "plug" is being relegated to the discard by the increasing popularity of travel by automobile.

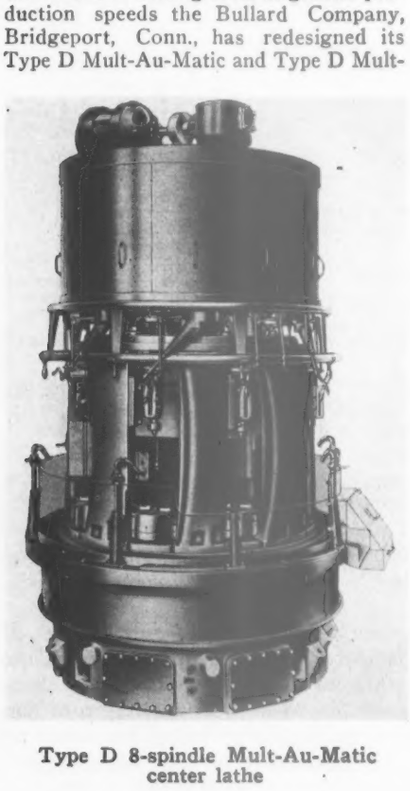
Residents of towns between Topeka, Kan., and Kansas City, Mo., recently mourned the passing of the Topeka "plug" of the Sante Fe, which had operated for more than 50 years between these points. For decades the "plug" left Topeka at 7:40 in the morning and arrived at Kansas City at 9:30. While it was only a local train it was regarded as one of the regulars of the Santa Fe service. It had an exceptional record for on-time performance and it is said that hundreds of people living in the Kaw valley between Topeka and Kansas City set their clocks daily by the train. In fact the train is supposed to have had the longest continuous record of on-time service of any train on the entire Santa Fe system.

The decline of patronage on the train began when paved roads had been completed between Topeka and Kansas City. Prior to that time it had always done an excellent business. In the old days, when everyone who amounted to anything in politics or business rated a pass, "deadheads" constituted the greater part of its passenger list. But subsequently, when the restrictions on the issuance of passes went into effect, cash customers filled the train and it was a profitable enterprise.

NEW DEVICES

Bullard Mult-Au-Matics

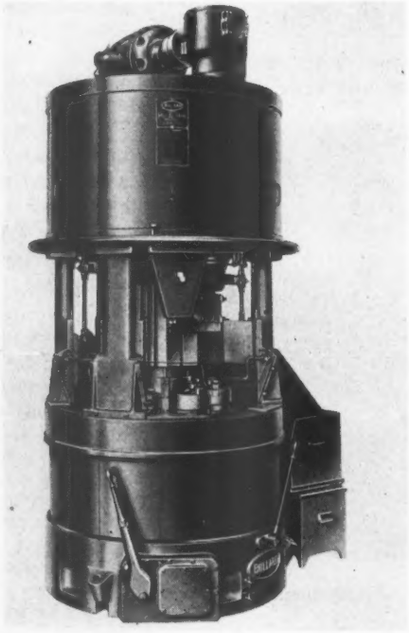
To meet a demand for machines to handle present-day machining operations with modern cutting tools at greater production speeds the Bullard Company, Bridgeport, Conn., has redesigned its Type D Mult-Au-Matic and Type D Mult-Au-Matic center lahte and, in addition, has brought out a Type C Mult-Au-Matic for smaller work. The new machines, made in eight as well as six-spindle sizes, are adapted to that field of work where operations upon chucked work require multiple spindles combined with multiple tooling at each spindle and the proper speeds and feeds for each set of operations.



Type D 8-spindle Mult-Au-Matic center lathe

The Type D machines incorporate heavier construction with resultant absorption of vibration, 100 per cent automatic lubrication, a variety of multiple tool-carrying heads and drill heads to meet any requirements, increased power, increased speeds and feeds and anti-friction bearings. The three major working elements of the machine—spindles, feed works and tool-carrying heads—are co-ordinated in their functioning by the manner of construction wherein the machine proper is mounted upon a massively built cylindrical base and the tool-carrying heads and feed works are secured to a rigid column. The work spindles, six or eight in number, are of heat-treated forged steel, each mounted on a pair of well lubricated anti-friction roller type bearings. Each spindle is equipped with a drive gear of sufficient capacity to permit an application of driving power in excess of cutting requirements. The spindles of the Type D Mult-Au-Matic are equipped with an individual spindle brake mechanism which, during index, brings all spindles to a stop, thereby insuring rapid and quiet re-engagement of gears. The feed works on the six- and eight-spindle Mult-Au-Matics are mounted throughout in anti-friction bearings. The tool heads have been redesigned and, in addition to being considerably strengthened, slide in hardened ways. Automatic slide lubrication has been included as a part of the regular lubricating system.

The lubricating system consists of a continuously driven gear pump which delivers oil from the reservoir to filters where all impurities are removed. The oil then passes through the drive bracket, is distributed to the feed works and thence to the tool heads and other moving parts of the machine. An independent oil line delivers pure filtered oil to the spindle bearings. The cutting compound system is an integral part of the machine.



Type C 6-spindle Mult-Au-Matic

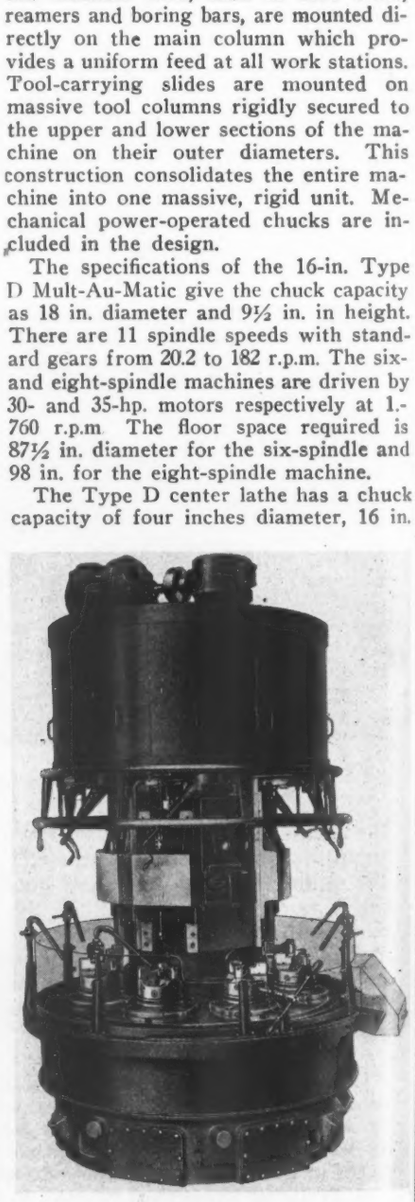
The highest grade of properly heat-treated alloy steel is used for shafts and gears. Steel castings have been replaced by steel forgings of selected analysis and bronze bushings have been replaced by anti-friction bearings throughout the construction of the machines.

The Type C Mult-Au-Matic is built in six- and eight-spindle models. Five or seven stations are for the machining operations in process, while simultaneously at the remaining station the work is being chucked. At the respective work stations there may be mounted a variety of boring, drilling and reaming tools in conjunction with a variety of turning and facing tools. These tools are set to meet the work conditions for each operation, and from a feed unit receive their proper feeds and spindle speeds at each station through a combined system of cam and change gears which actuates the main turret and tool heads.

Through the combination of main head and tool column heads at each of the work stations it is possible to approach the smaller work for which this machine is designed from different directions for concentrated operations at close quarters and still maintain in the retired position sufficient room for easy tool setting. In this machine tools, such as core drills, reamers and boring bars, are mounted directly on the main column which provides a uniform feed at all work stations. Tool-carrying slides are mounted on massive tool columns rigidly secured to the upper and lower sections of the machine on their outer diameters. This construction consolidates the entire machine into one massive, rigid unit. Mechanical power-operated chucks are included in the design.

The specifications of the 16-in. Type D Mult-Au-Matic give the chuck capacity as 18 in. diameter and 9½ in. in height. There are 11 spindle speeds with standard gears from 20.2 to 182 r.p.m. The six- and eight-spindle machines are driven by 30- and 35-hp. motors respectively at 1,760 r.p.m. The floor space required is 87½ in. diameter for the six-spindle and 98 in. for the eight-spindle machine.

The Type D center lathe has a chuck capacity of four inches diameter, 16 in.



Type D 8-spindle Mult-Au-Matic

between centers with 11 spindle speeds varying from 46.8 to 421 r.p.m. using standard gears. The six-spindle machine is driven by a 25-hp. motor while the eight-spindle machine uses a 30-hp. motor, both operating at 1,760 r.p.m. The floor space required for these machines is 78½ in. diameter and 87½ in. diameter, respectively. The height, not including the motor, is 136¾ in.

The Type C Mult-Au-Matic has chuck capacity of 6¾ in. diam. and 6 in. high. Nine spindle speeds provide a range from 17 to 707 r.p.m. The six-spindle machine is driven by a 20-hp. motor and the eight-spindle machine uses a 25-hp. motor. The six-spindle machine requires floor space of 55½ in. diam. and 121¾ in. high while the eight-spindle machine requires 65¾ in. diam. and 130¾ high.

Bushing-Truing Machine

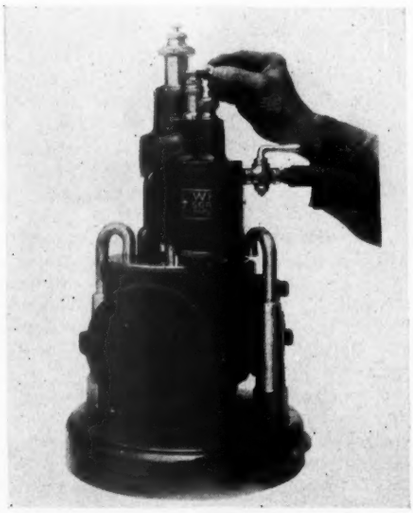
The illustrations show the first of a series of air-brake maintenance machines developed for the railroad department of the Whiting Corporation, Harvey, Ill., by Owen D. Kinsey, formerly tool supervisor of the Illinois Central and the Milwaukee. This triple-valve repair tool, pneumatically powered with a built-in motor, weighs 25 lb. and is 10 in. high. It is equipped with a tungsten-carbide cutting tool automatically controlled for a pre-determined depth of cut of only .0005 in. The time required to rebore a triple valve varies from 1½ to 3 min., floor to floor. The finish and accuracy are said to be superior to that obtained by grinding.

The tool spindle has a micro adjustment at its top end, with graduations of .00025 in. At the lower end of this spindle are located the centering jaws, one of which is fitted with the adjustable cutting tool equipped with tungsten carbide, one of the few metals which will successfully cut the burnished hard surface of the bushing when making light cuts. Above the micrometer adjuster is the top nut used for locking purposes after adjustments are obtained.

Triple-valve bushing-truing machine with the Carboloy tool being set out for boring operations

Next to the tool spindle is the control gear. Its knurled collar, when pushed down, sets the tool downward and, when pushed up, moves the tool upward. Upward and downward movements of the tool are stopped automatically when reaching extreme positions. When the control gear is in mid-position, the tool spindle stops rotating only. In this position, the rotating movement of the control gear makes possible the grinding of the cutting tool on the top surface of the knurled nut. Diamond dust is used as an abrasive. The motor spindle on the drawing also is equipped with a knurled top for turning the spindle by hand to the operating position of the motor.

In operation, the machine is placed on a triple valve or control valve, as illustrated, the micrometer on top of the spindle being turned to the right as far as it will go, thus centering the machine and indicating the exact size of the bore in quarter-thousandths of an inch. It also sets the tungsten-carbide tool to a fixed depth of .0005 in. After this operation, the cutting tool is locked with a screw driver and the machine clamped in its centered position, the micrometer being turned back about one turn to contract the center jaws. The control is set for quick-return position and the power turned on, raising the spindle to the up or starting position. The motor is then shut off. After adjustments are made, the control gear is pushed down and power again applied in order to run the cut. When desired, a holding fixture equipped with a lapping plate may be purchased for lapping slide valves, graduating valves, etc.

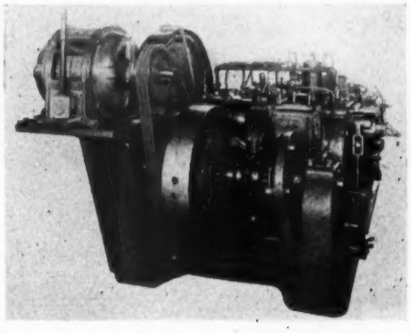


The control spindle revolving at high speed sharpens the boring tool with diamond dust as an abrasive

This triple-valve bushing-truing machine is made in a 3½-in. size for K1 and K2 triple valves, and a 4¾-in. size for L3 triple valves and UC valves. The maximum bore obtainable is .040 in. over the original size. The working speed of the tool is 500 r.p.m. and of the motor 6,000 r.p.m. The spindle feed of the tool is .004 in. per revolution with a quick, vertical return movement of the spindle of ¼ in. per revolution.

Acme Friction Drive Forging Machines

The Acme Machinery Company, Cleveland, Ohio, has made radical changes to its line of forging machines by the adoption of a friction type of drive.



Rear view of the Acme machine showing the friction drive and the operating clutches

The design of this drive is such that it gives instantaneous starting the moment the foot treadle is pressed down by the operator. It is simple in design, the fly-wheel being the only machine member rotating while the machine is idling. A slight pressure on the foot treadle releases the energy of a spring which engages a driving clutch. The machine then moves through the heading and recede cycle and on the return of the recede stroke the driving clutch is disengaged and the braking clutch is engaged. The contour of the cam is such that the crank is always stopped and held at the same position on the extreme back end of the stroke. While the cam is operating the clutches from the driving to the braking action the spring is also being compressed for the next operation. The clutches are of rugged construction having large friction surfaces which reduce to a minimum the pressure per square inch required to drive the machine.

This type of drive eliminates a great part of the noise of the machine while in operation and serves to cushion the starting and stopping action which reduces greatly the element of shock to the machine parts and motor. Likewise, if the machine is stalled due to over-load, the clutch cushions the stopping of the fly-wheel.

In conjunction with the friction drive other improvements have been made to the Acme machine. The cam movement for closing the dies is such that the dies are closed and held closed with a uniform grip during the long heading and recede cycle. The fully suspended header and movable die slides are placed above a point where water and scale may attack them. The pitman pin is an integral part which takes a full bearing through the entire width of the header slide. Integral toggle pins back up the dies with a

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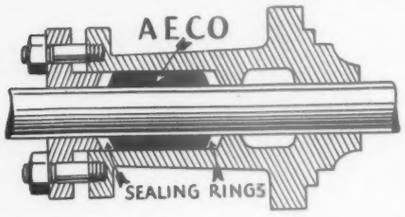
continuous bearing through their entire height. A vertical automatic relief placed so as not to increase floor space or hazard provides for such emergencies as the work becoming caught between the flat faces of the forging dies. The relief mechanism when operated automatically straightens out at the end of the stroke and is ready for the next operation without the necessity of replacing a shear pin or breaker bolt.

Plastic Metallic Packing

A plastic metallic packing, manufactured and sold by the A. & E. Co., 3166 Lincoln avenue, Chicago, is being successfully tested for packing locomotive throttle rods, power-reverse gears, etc.,



Cross section showing how Aeco plastic metallic packing fits the stuffing box

as well as for miscellaneous pump packing purposes in railway shops and power plants. The particular advantages of this new packing, called "Aeco," include ease of application and renewal, durability, reduced friction and the maintenance of steam- and fluid-tight joints under the most adverse conditions as regards vibration, temperature changes, expansion, contraction, etc.

Aeco is a plastic self-forming packing, composed of porous all-metallic kernels, saturated with non-drying lubricants. The physical characteristics are said to be such that it will not dry out or harden, but, owing to the maintenance of a plastic condition for a long period of time, will accommodate itself to the rod or valve stem being packed under varying conditions and provide a tight joint without dragging or binding experienced with less flexible packing materials. Owing to the self-lubricating properties of the packing, substantially less oil or other lubricant is said to be required than with other types of packing.

This packing is adaptable for use in any size of stuffing box. It is molded into cakes and, when broken up and placed in the stuffing box, it forms a ring bearing around the rod when the gland is tightened. As shown in the illustration, sealing rings are used to prevent small particles of the packing from blowing or dragging through until it is set. Any soft packing, or plain hemp, in some cases, may be used for sealing rings. When repacking a stuffing box, it is not necessary to remove the old packing, but simply to loosen the gland and add a sufficient amount of new packing which will unite with the old packing to provide a single homogeneous ring of metallic packing around the rod when the gland is tight.

Aeco packing is made in several grades for saturated steam, hot and cold water, air, gases, brine and other materials for temperatures up to 600 deg. F. The same material in a finer grade is used for bronze sleeves, valve stems, or where the diameter of the rod or shaft is less than one inch. Other grades are available for superheated steam temperatures, for extra-heavy duty or other special uses.

Pipe Threading And Cutting Machine

The Landis Machine Company, Inc., Waynesboro, Pa., has added another pipe threading and cutting machine with receding chaser die head and leadscrew to its line of pipe machines.

This machine, known as the 13⅜-in. size, has a capacity of 4½ in. to 13⅜ in. O.D. It will generate a tapered pipe thread of any length up to and including 8 in. and any tapers of ¾ in. per foot and less on all pipe, casing and tubing sizes within its range.

The receding chaser feature reduces the cutting strain on the chasers to that required for a straight thread of like diameter and pitch and insures superaccuracy and an exceptional finish. It also permits the use of a very narrow chaser which lowers the initial chaser cost and adds to the life of the chasers between grindings.

The die head has a universal adjustment for size. In addition there is a micrometer adjustment for the final setting. Each graduation on the micrometer dial gives a variation of .001 in. in diameter.

The die head is a two-cut head and can be used for roughing and finishing. The roughing and finishing cuts are controlled by the same receding mechanism. The finishing cut can be made without any change in the diametrical adjustment.

The chaser holders of the die head cover a range from 8⅝ in. to 13⅜ in. but chaser-holder extensions, having a range from 4½ in. to 8⅝ in, can be fitted to the chaser holders so as to give the die head a total range of 4½ in. to 13⅜ in. inclusive.

A chaser, 1-15/16 in. in width, is employed for all thread lengths. The chasers have an initial length of 4 in., but they may be used in the chaser-holder extensions after they have been ground to a 3-in. length or less. The same chasers can be used for any pipe size within the ranges of the chaser holders or chaser-holder extensions, as long as the pitch, taper and thread form are constant.

The taper mechanism generates a straight-line taper or a taper which is uniform throughout the entire thread length. The sine bar is easily and quickly adjusted for all tapers. A tapered plug provides a positive means for locating the sine bar for the 3/16-in., ⅜-in. and ¾-in. tapers.

The sine-bar retarding bracket, which actuates the taper mechanism, is adjustable for the length of pipe extending beyond the face of the chuck. It is set to have contact with the sine bar at the start of the thread. An automatic safety device releases the sine-bar retarding bracket should the operator neglect to open the die head at the finish of the thread.

The lead screw is located centrally between the guides of the machine and takes the load without binding the carriage. It has a coarse-pitch thread with a round crest to facilitate the engagement of the nut.

The lead-screw nut is of the split (full-nut) type and is made of bronze. The two segments are mounted in a steel carrier. They have contact with and take the thrust load directly from the carriage. The engagement surface of the lead-screw nut is lubricated automatically from a reservoir in the carriage.

The lead-screw nut is engaged by hand. It may be disengaged either automatically at the end of the cut or by hand. A pitch indicator is provided to assist the operator in the engagement of the lead-screw nut.

The pitch change gears are housed in a gear box at the headstock end of the machine. The intermediate gears are mounted on a floating carrier of a new and original design which greatly simplifies the meshing operation. A single nut clamps the intermediate gears and their carrier in place.

The cutting coolant is supplied to the chasers through ducts in the bore of the die head. These ducts are located so that the cutting edge of each chaser

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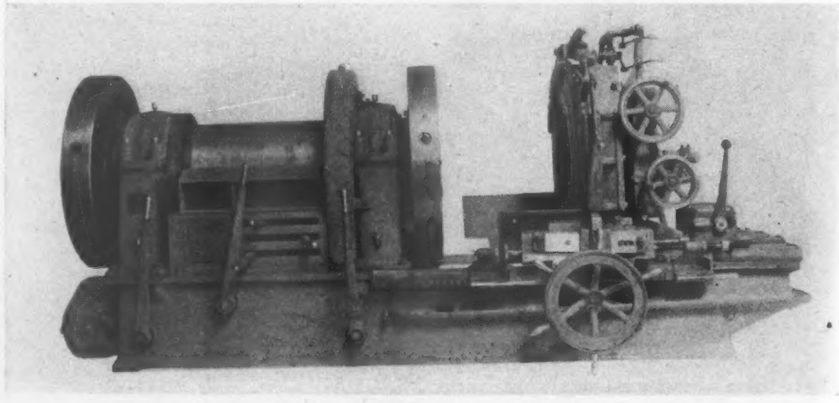

Landis pipe machine with receding chaser die head and lead screw

WHATEVER your tube troubles TONCAN IRON WILL HELP THEM

If bad water is eating away your boiler tubes, Toncan Iron, the modern alloy of refined iron, copper and molybdenum, will improve the situation. It has superior resistance to corrosion.

If welded tubes split in the seam, replace with Toncan, the only seamless iron boiler tube.

If tubes work or weld with difficulty, or are subject to fire-cracking after working, apply Toncan Tubes—you will find them free from such troubles.

Wherever boiler tubes are giving trouble, replace with Toncan Iron.

REG. U.S. PAT. OFF.
TONCAN
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Toncan Iron Boiler Tubes, Pipe, Plates, Rivets, Staybolts, Tender Plates and Firebox Sheets
Sheets and Strip for special railroad purposes
Agathon Alloy Steels for Locomotive Parts
Agathon Engine Bolt Steel • Nitralloy
Agathon Iron for pins and bushings
Agathon Staybolt Iron • Culverts
Climax Steel Staybolts • Upson Bolts and Nuts
Track Material, Maney Guard Rail Assemblies
EnduroStainless Steel for dining car equipment, for refrigeration cars and for firebox sheets
Agathon Nickel Forging Steel (20-27 Carbon)

REPUBLIC STEEL CORPORATION
General Office: Youngstown, Ohio

is flooded with the coolant. Quick-acting valves control the supply of the cutting coolant to both the chasers and the cutting-off tool.

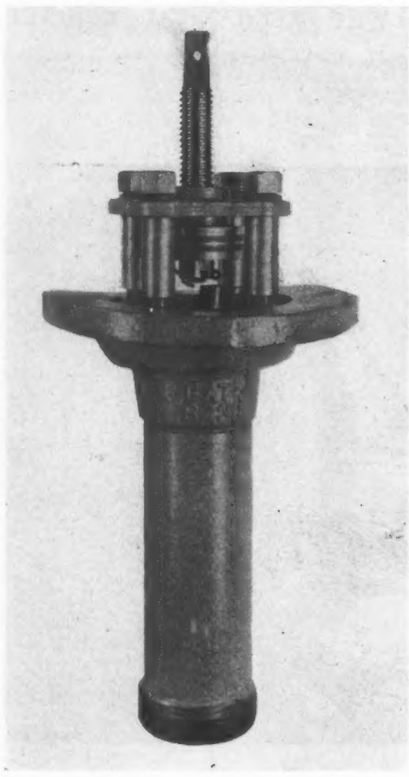
Provision is made for lubricating all sliding and rotating surfaces of both the die head and the machine.

Bottom Outlet Valve For Tank Cars

A bottom outlet valve for tank cars which utilizes both steel and resilient material to seal the outlet opening against a metal seat has been developed by the General American Tank Car Corporation, Chicago. This valve, which is known as the Pierce resilient seated outlet valve, has been tested and approved for service by the Tank Car Committee of the Mechanical Division, American Railway Association.

The construction of the valve will be readily understood by an inspection of the drawing which shows a cross-section through the valve and the bottom outlet leg. In applying the valve to existing tank cars or utilizing existing outlet legs, a recess is machined in the outlet casting, without removing it from the tank, to receive the bronze seat for the Pierce valve. The valve seat is sealed in the outlet by the use of a gasket at the bottom of the recess and is held in place by sleeves which are slipped over the studs and rest on lugs cast on the top of the valve seat. The cross into which the valve stem is threaded in turn rests on top of the sleeves and the entire assembly is secured by nuts and lock washers on the studs.

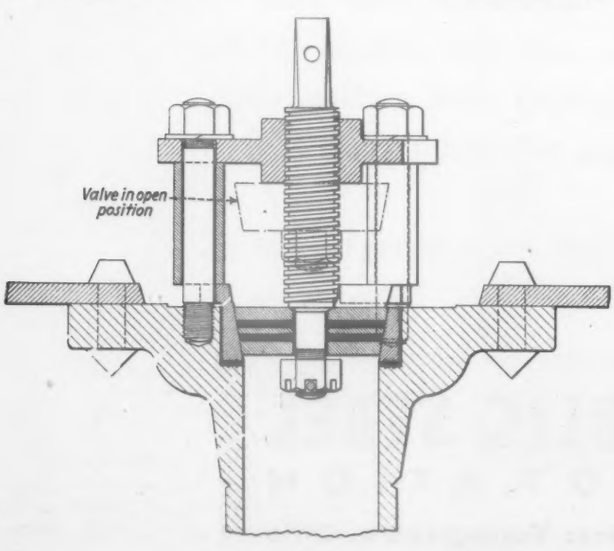
The valve itself is made of three stainless steel discs which are separated by two discs of a resilient material resembling rubber in its mechanical properties, but immune to the action of hydro-carbon oils. The discs are machined on a mandrel on which they are mounted with a separation 1/16 in. less than the normal thickness of the resilient discs to be used between them. The circumference is then finished to fit the taper of the bronze seat.



The valve assembled in the outlet eg

In closing the valve the bottom disc first seats and the discs of resilient material are then successively compressed by 1/16 in. each before the other two metal discs are successively brought to a seat. The action of the valve in closing tends to clear the seat of dirt. However, any slight obstruction which may prevent one of the discs from tightly seating does not interfere with the seating of the others since the resilient material will compensate for a slight lack of relative alinement between the steel discs. Except for such conditions, the compression of the resilient material is definitely limited to 1/16 in. on each disc and it cannot fail by crushing.

Since the valve is not guided by wings it offers an unobstructed passage through the outlet leg when in the open position. Tests indicate that the new 4-in. valve has a capacity in excess of 6-in. wing valves.

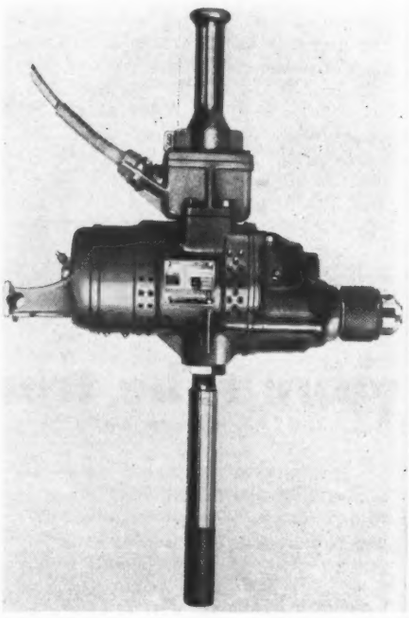


The Pierce resilient seated bottom outlet valve—Patent has been applied for

Thor Drilling and Honing Machine

The latest addition to the Thor line of universal electrical tools, manufactured by the Independent Pneumatic Tool Company, 600 West Jackson boulevard, Chicago, is a combination drilling and honing machine—the UFH.

This machine has ball bearings throughout and is designed to develop greater power and torque and higher speed. This increased speed is an advantage in honing cylinders as a smoother job is obtained.



The Thor model UFH is designed for drilling and honing

The drilling capacity is 5/8 in. Reaming capacity is 9/16 in. The length overall is 18 in. Spindle offset is 1 13/16 in. The weight is 25¾ lb. This type machine can be had with a 5/8-in. Jacobs chuck for drilling up to 5/8 in. or for driving the cylinder hone, or with No. 2 Morse taper for drilling up to 7/8 in.

A Series of Hearings to be held in New York from February 1 to February 14 in connection with the Interstate Commerce Commission's investigation of the practices of the railroads in connection with the purchase and handling of locomotive fuel has been announced by the commission. This inquiry is Part 1 of the Commission's general investigation of practices of carriers affecting operating revenues and expenses. Other hearings are to be held at Pittsburgh, February 23 to 26; Detroit, February 29 to March 4, and Chicago, March 7 to March 21, before Examiner Charles W. Berry.

(Turn to next left-hand page)

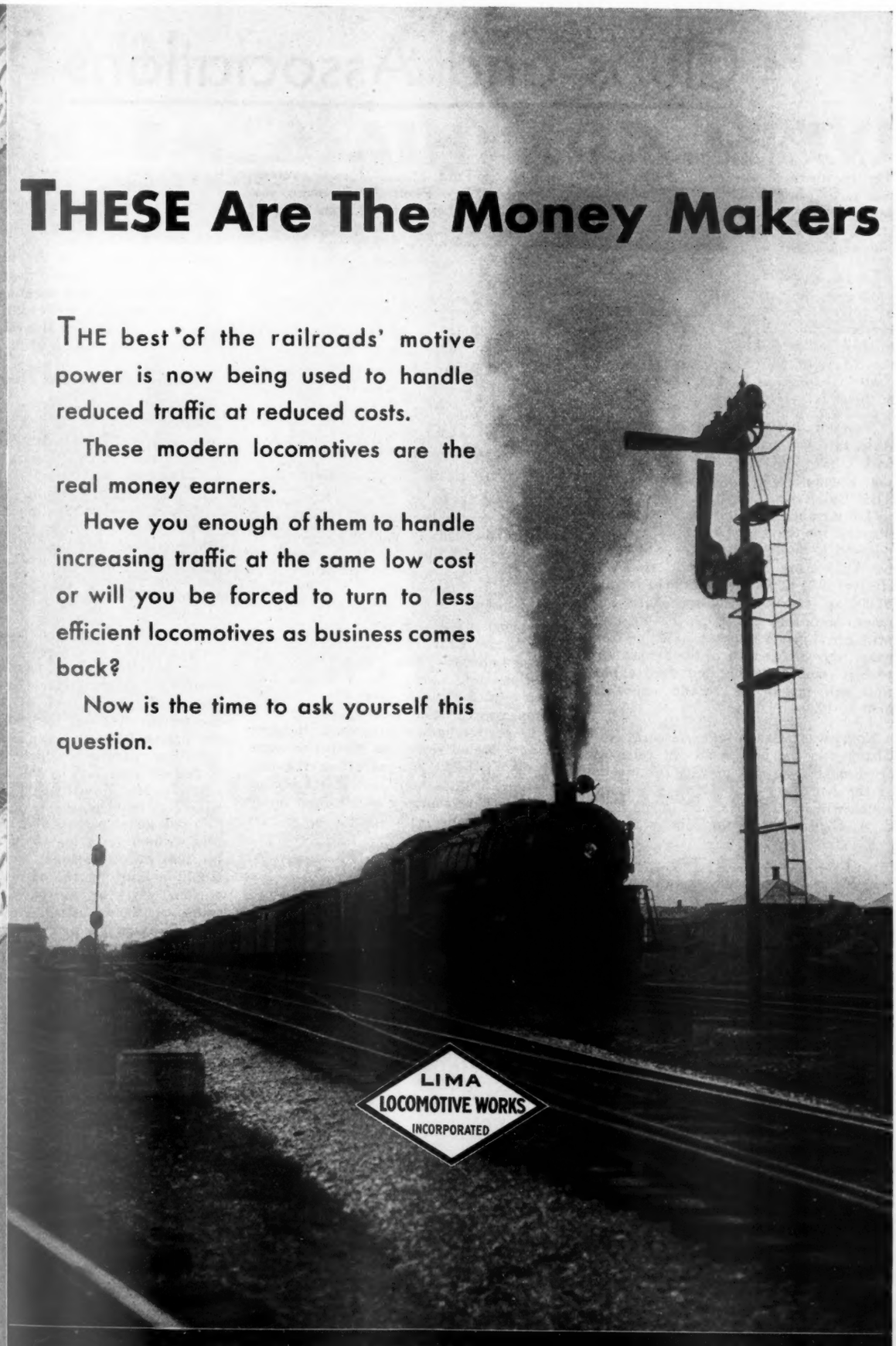
THESE Are The Money Makers

THE best of the railroads' motive power is now being used to handle reduced traffic at reduced costs.

These modern locomotives are the real money earners.

Have you enough of them to handle increasing traffic at the same low cost or will you be forced to turn to less efficient locomotives as business comes back?

Now is the time to ask yourself this question.



LIMA LOCOMOTIVE WORKS · Incorporated · LIMA, OHIO

Among the Clubs and Associations

EASTERN CAR FOREMEN'S ASSOCIATION.—The members of the Eastern Car Foremen's Association will meet at 8 p.m. on January 22 at 29 West Thirty-ninth street, New York, to discuss the A. R. A. Interchange Rules.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A film showing the manufacture of refractories will be presented by the Harbison Walker Refractories Company of Birmingham, Ala., at the meeting of the Southern and Southwestern Railway Club to be held at 10 a.m. on January 21 at the Ansley Hotel, Atlanta, Ga.

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION.—At a meeting at Cincinnati, Ohio, on December 18 the Exposition Committee of the National Machine Tool Builders' Association allotted space to 110 member exhibits which are already planned for the Third Machine Tool Exposition to be held at the Cleveland Public Auditorium September 10 to 17, inclusive, 1932. This first allotment involves 61,000 sq. ft. of display space and indicates, according to Ralph E. Flanders, manager, Jones & Lamson Machine Company, who is chairman of the association's exhibit committee, that the third exposition will match the second exposition held in 1929.

NORTHWEST CAR MEN'S ASSOCIATION.—Changes in the new A. R. A. rules will be discussed at the January 18 meeting of the Northwest Car Men's Association which will be held at 8 p.m. in the Y. M. C. A. Gym room of the Minnesota Railway, St. Paul, Minn. ¶ At the meeting held at St. Paul, Minn., Monday evening, December 21, "Flour Cars" were discussed, the meeting being something of an innovation in that it constituted essentially a discussion or debate regarding the necessary physical characteristics of box cars intended for flour loading. The debate was participated in by A. N. Williams, general superintendent, Soo Line, Minneapolis, Minn.; H. R. Grochau, assistant freight claim agent, the Omaha, St. Paul, and J. H. Remick, general car inspector, Northern Pacific, St. Paul.

Club Papers

Air Brake Equipment

The Manhattan Air Brake Club.—Meeting held November 20, 1931, Room 2300, 150 Broadway, New York. ¶ The following topics were discussed at the November meeting of the Manhattan Air Brake Club: Air-Brake Equipment on the Reading's Multiple-Unit Cars; No. 6-RC Brake Equipment for Gas-Electric and Oil-Electric Cars; Braking Ratio for Caboose Cars; Caboose Valve; Anti-Freezer for Multiple-Unit Cars; No. 4 Brake Pipe Vent Valve-Strainer, and 8½-in. C. C. Compressor Piston Valve Bushing. ¶ B. P. Lerch, mechanical supervisor, Reading, made a verbal report on the performance of the air-brake equipment on the new Reading Multiple-unit cars and said that it compared favorably with other equipment, especially with respect to shorter stopping distances. Forty per cent braking ratio was constituted to be the generally recommended figure for light and heavy caboose cars. Unless passenger cars used as cabooses are assigned permanently for such service, no change is made with respect to the braking ratio. ¶ Two subjects were held over for discussion at the December meeting: Reducing Valve for Single Car-Testing Device and Operation of Air Signal System on Long Express Trains and on Milk Trains.

* * * *

Photo by M. Kettel, Geneva.

"Diner" recently placed in service for employees of the Electric Street Railways Company, Geneva, Switzerland. The car has an electric kitchen and is comfortably and modernly equipped throughout

Railway Patents Discussed

Western Railway Club.—Meeting held November 16 at the Hotel Sherman, Chicago. Subject "Patents and Railway Progress," presented by Charles L. Howard, assistant general counsel, Western Railroad Association, Chicago. ¶ This subject of keen interest to railway men, was presented in a masterly manner by Mr. Howard who said that no industry is more vitally interlocked with patents and inventions than the railroads. Mr. Howard pointed out in some detail the accomplishments of railroad inventors, referring to the origin of the link motion, power reverse gear, feedwater heater, variable exhaust, air brake, draft gear, automatic coupler, superheater, mechanical stoker, and other devices. He outlined briefly the benefit received by inventors under the patent laws and explained the constitutional provision which makes patent protection possible. In the course of his remarks, Mr. Howard paid the following tribute to railway supply manufacturers: "To talk about patents and railroad progress without referring to the part played by the railway supply manufacturers would be omitting one of the outstanding reasons why the railroads lead in the transportation industry. The facilities of the railway supply manufacturers for developing and perfecting new inventions have made the great progress of the railroads possible."

Railway Research

Western Railway Club.—Meeting held December 14 at the Hotel Sherman, Chicago, being a joint session of the Western Railway Club, Western Society of Engineers, American Society of Mechanical Engineers—Chicago section—and American Railway Engineering Association. Subject "The Problems and Possibilities of Railway Research." Speaker C. T. Ripley, chief mechanical engineer, Atchison, Topeka & Santa Fe, Chicago. ¶ In one of the most interesting meetings recently held by this club, Mr. Ripley covered in general the subject of research activities in practically all departments of steam railroad work. He made quite a strong appeal for a central research laboratory for the benefit of all the railways,

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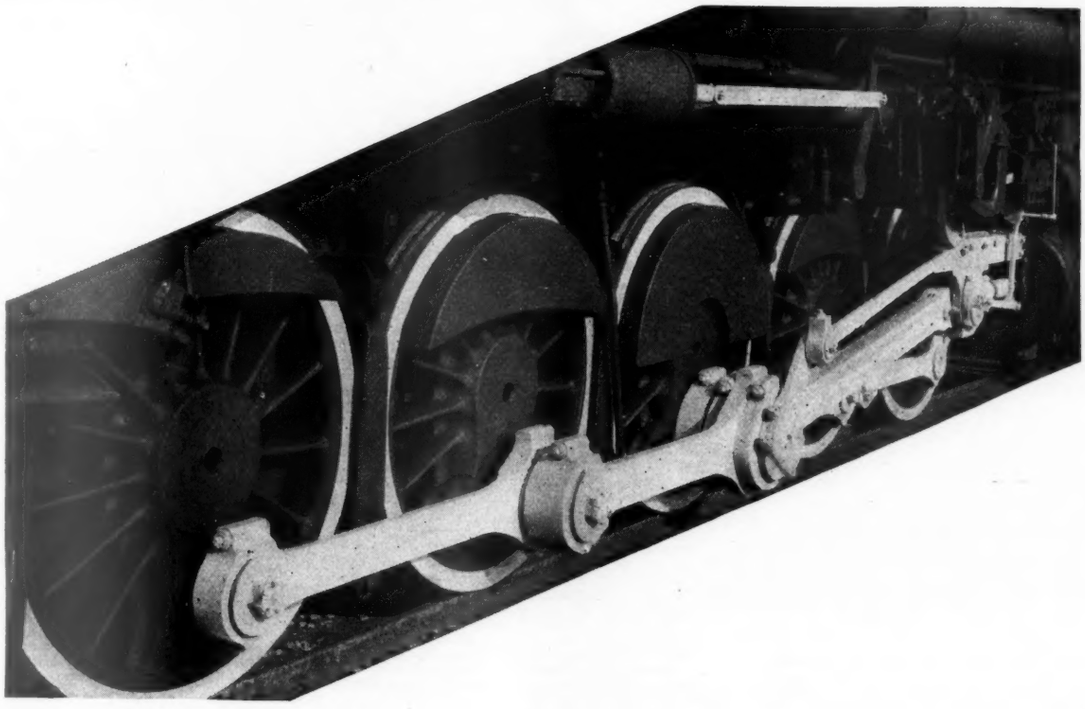
AGAIN—
TANDEM MAIN ROD DRIVE



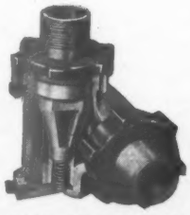
Cuts Down Maintenance

WITH ordinary side rods, 2-10-2 type locomotives were averaging 30,300 miles between shoppings at a cost of $.0176 per mile for rod maintenance.

With Tandem Main Rod Drive, similar 2-10-2 type locomotives in exactly the same service averaged 36,800 miles between shoppings and reduced rod maintenance to $.00294 per locomotive mile.

Here is further evidence that the Tandem Main Rod Drive reduces maintenance costs to a fraction of what they have been.

In addition, the availability of the locomotives was increased 20%.



THE FRANKLIN SLEEVE JOINT
Uses flat gaskets—the cheapest to buy when replacement is necessary

FRANKLIN RAILWAY SUPPLY CO., INC.
NEW YORK CHICAGO MONTREAL

citing, to illustrate what might be accomplished, the results already achieved in the testing of draft gears and air-brake equipment at Purdue University, under the direction of H. A. Johnson, director of research, American Railway Association. ¶ Regarding the research activities of the future, Mr. Ripley said: "The demand upon research engineers at the present time is to develop equipment, track, etc., which will enable railways to give faster, safer and more comfortable service at lower costs, to enable us to meet competition. Practically all of the development work which is now going on is aimed at securing these results. ¶ Mr. Ripley mentioned the experimental work with high boiler pressures, internal combustion engines, lighter alloys, air conditioning of cars, improved lubrication, and more efficient power generation in stationary plants, closing his address with a word of caution against too drastic reduction of research activities, even during the present period of economic stress. Regarding this subject, Mr. Ripley said: "During depression, there is a necessity for cutting costs in every way, and some research departments have suffered from the reduction in forces as have other departments. However, I cannot help but make a plea that the greatest care be exercised before these particular activities are too greatly curtailed."

Car Men Can Influence Public Opinion

Chicago Car Foremen's Association.—Meeting held at the Auditorium Hotel, Chicago, December 14. Subject "The Car Department and Public Relations." Speaker C. D. Morris, assistant to the chairman, Western Railways Committee on Public Relations. ¶ In this address, which was listened to with the keenest interest by a representative group of car department supervisors and inspectors, Mr. Morris stressed particularly the present pressing problems and needs of the railways, as well as the opportunity and duty of every car department supervisor to acquaint himself with the facts and miss no opportunity to influence a favorable public opinion, both indirectly and directly, through contact with railway employees and the general public. ¶ A significant paragraph from Mr. Morris' address is quoted as follows: "What is needed in this hour is to show the American people that the railroad problem is their problem, quite as much as it is yours, or the officers of your road. It is the people's problem from the standpoint of ownership. They actually own and control the railroads and do not know it. In his last report as secretary of commerce, President Hoover declared that there were 50 millions of our people directly concerned in the returns from railroad investments. That is about 40 per cent of our population which, in my judgment, is too small. There are at this time approximately one million individual stockholders in our railroads, not to mention the fact that 60 million people in this country, who carry life insurance, have about one-third of the money out of which their policies are to be paid at the time of their death, invested in the securities of the railroads. There are about 40 million depositors in our savings banks, and 15 per cent of their deposits are likewise invested. The endowment funds of our colleges, our universities and our hospitals are likewise largely invested in these same securities. Practically every citizen of the land is a potential stockholder in the great industry in which we are employed. Self-interest alone ought to make every man an ardent friend of the railroads whether he is employed by them or not."

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—DIVISION V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I. — SAFETY SECTION. — J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H. streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Paul D. Mallay, chief engineer, transportation department, Johns-Manville Corporation, 292 Madison avenue, New York.

MACHINE SHOP PRACTICE DIVISION. — Carlos de Zafra, care of A. S. M. E., 29 West Thirty-ninth street, New York.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—L. H. Morrison, associate editor, Power, 475 Tenth avenue, New York.

FUELS DIVISION.—A. D. Black, associate editor, Power, 475 Tenth avenue, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid avenue, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce street, Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-Fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August. Auditorium Hotel, Chicago, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 608 South Main street, Los Angeles, Cal. Meetings second Monday of each month except July, August and September, in the Pacific Electric Club building, Los Angeles, Cal.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth streets, Council Bluffs, Iowa. Regular meetings, second Thursday of each month at Council Bluffs.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Weigman, 720 North Twenty-third street, East St. Louis, Ill. Regular meeting first Tuesday in each month, except July and August, at American Hotel Annex, St. Louis, Mo.

CENTRAL RAILWAY CLUB OF BUFFALO.—T. J. O'Donnell, executive secretary, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 453 East Sixth street, Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meeting second Monday each month, except June, July and August, at the Auditorium, Brotherhood of Railroad Trainmen's building, West Ninth and Superior avenue, Cleveland.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—P. M. Pursian, 823 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month at Hotel Severin, Indianapolis, at 7 p.m. Noon-day luncheon 12:15 p.m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. T. Winkless, Room 707, LaSalle Street Station, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION. — A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Car Department Officers Association.

NATIONAL SAFETY COUNCIL—STEAM RAILROAD SECTION.—W. A. Booth, Canadian National, Montreal, Que. William Penn and Fort Pitt Hotels, Pittsburgh, Pa.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September. Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—Douglas I. McKay, executive secretary, 26 Cortlandt street, New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting third Monday each month, except June, July, and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

PUEBLO CAR MEN'S ASSOCIATION.—I. F. Wharton, chief clerk, Interchange Bureau, Pueblo, Colo.

RAILWAY BUSINESS ASSOCIATION. — Frank W. Noxon, 1124 Woodward building, Washington, D. C.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett. Baltimore & Ohio, Baltimore, Md.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION. — E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—J. A. Murphy, 1405 Canadian National Express building, Toronto 2, Ont. Meetings third Monday of each month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION. — W. O. Thompson, 1177 East Ninety-eight street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—J. H. Nash, 343 South Dearborn street, Chicago. Regular meetings, third Monday in each month.

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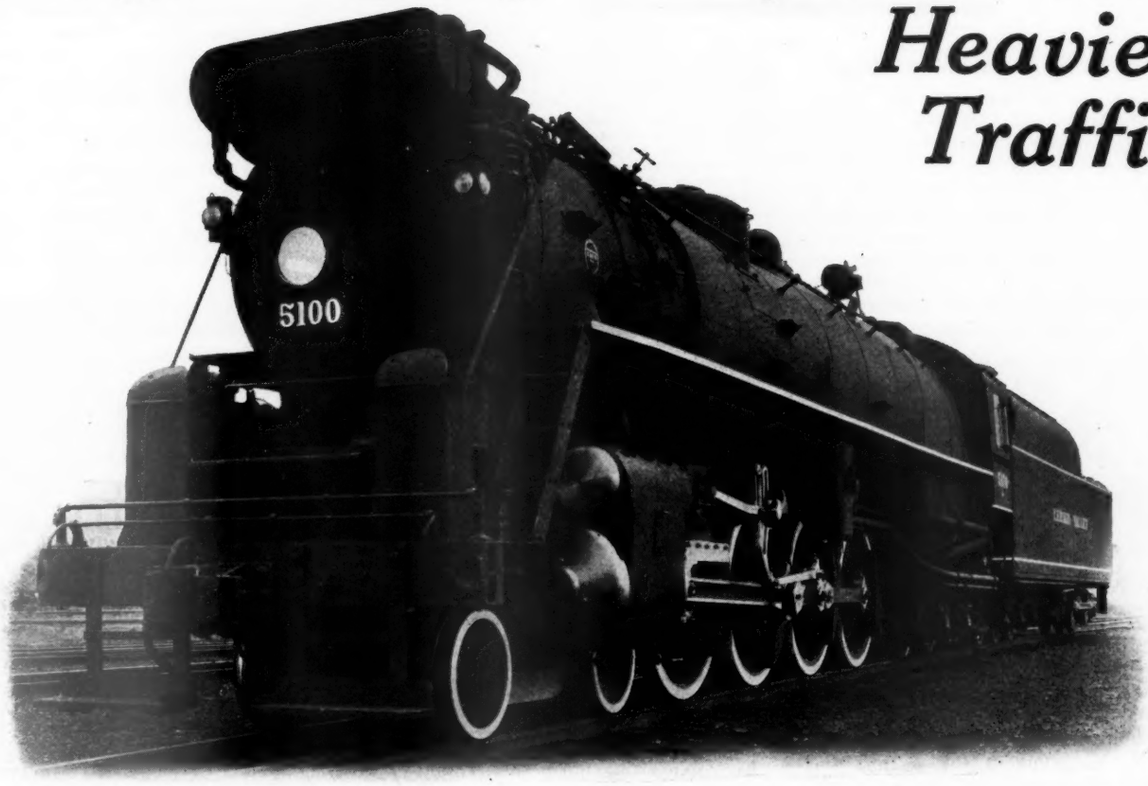
Lehigh Valley Prepares For Heavier Traffic



EARLY in 1931, the Lehigh Valley placed in service a trial locomotive of the 4-8-4 type built in our Shops. It was designed to handle 3000 tons from Buffalo to Jersey City on a fast freight schedule, and in operation, materially exceeded that requirement.

On the Seneca Division where the locomotive was given a series of dynamometer tests, it demonstrated its ability to handle 500 ns more than the Mikado type locomotives used in fast freight service, and to save 20 minutes on their running time.

We are now building ten more for the Lehigh Valley. They were ordered because—

It takes Modern Locomotives to make money these days!

MATTHIAS W. BALDWIN
FOUNDER 1831

THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

NEWS

Fire at P. R. R. Altoona Shops

FIRE causing an estimated loss of between $1,500,000 and $2,200,000 destroyed the central section of the Altoona machine shops, a unit of the Pennsylvania's, Altoona (Pa.) works, on the morning of December 27. The departments destroyed were the bolt, telegraph, electric, air brake, machine and two erecting shops.

Running-Board Tests Extended Six Months

THE INTERSTATE COMMERCE COMMISSION has extended from January 1 to June 30, 1932, the time allowed in its order of January 29, 1930, to permit certain railroads to continue tests with running boards, on box or other house cars, made of material other than wood. This order modified the provisions of the safety appliance order of March 13, 1911.

Fire at N. Y. O. & W. Middletown Shops

FIRE of undetermined origin, which destroyed a carpenter shop, a car repair shop and a small adjoining shop, and damaged a large machine shop, caused a loss estimated at $300,000 at the Middletown, N. Y., shops of the New York, Ontario & Western on January 2. In addition to the financial loss, which was covered by insurance, about 300 employees were thrown out of work as a result of the fire.

"Will Container System Dominate Rail Transport?"

"Will the container system eventually dominate rail transport?", the Railway News Letter, issued by the British Railways Press Bureau, asks in a recent article. "Introduced only a few years ago as an experiment," the article continues, "the container has captured the confidence of British shippers to such an extent that the railways can scarcely get containers built quickly enough to meet demands. In 1925 they could be numbered in tens; in 1928 there were 350; now the total number owned by British railways is over 6,000 of varying types constructed to accommodate the numerous classes of freight, while hundreds more are on order.

"The primary attraction of the container is the fact that it can be used equally on rail or road, thus affording 'door-to-door' delivery of fragile and perishable as well as more robust traffic, without transshipment or repacking, thus avoiding possible damage, deterioration, or loss during transshipment."

Building costs are being cheapened by virtue of the fact that bricks and tiles of the best quality can be loaded at the brick-fields into containers, thence conveyed by rail and road to the building sites, and, if required, actually craned to the particular part of the building where the bricks are needed.

Take glass. A big glass-ware firm in Barnsley recently decided to give containers a trial. They loaded two containers with 12,960 glass tumblers, which arrived at their destination with but one tumbler broken. Result—the firm has developed the use of this means of transit to an enormous extent. These experiences are rapidly becoming the commonplaces of freight transport.

Household removals can now be undertaken with containers by the railways, which have made arrangements to cover the services connected with the whole removal, including laying linoleum and hanging pictures. Removal contractors have a firm friend in the container. It is a replica of their own road van, and can be loaded as expeditiously and handed over to the railway company for the complete journey to the new abode, saving, perhaps, a day or more on the journey.

Insulated containers are now used in the midlands and north for the "shop-to-shop" delivery of meat, the railway acting the part of distributor on behalf of the wholesaler.

Specially insulated containers now enable express meat services to be run by road direct from Southampton docks to towns within a radius of about 60 miles, while fast trainloads of meat in insulated containers run daily from the ports of London, Southampton, Avonmouth, Liverpool, Hull, etc., to all parts of the country.

British containers are in constant use between British ports and the Continent. They do not carry coals to Newcastle, but they do take fruit abroad. Bananas and delicate fruits pass regularly in containers from the Southampton, Avonmouth and London docks to the Channel Islands and continental destinations.

A large consignment of theatre seats was recently sent in containers from the factories at Birmingham to Paris. Electrical machinery is passing regularly by this system from Brighton to Paris.

Another interesting development is the despatch of frozen salmon to the Continent. This is received from Labrador, kept in cold storage at the home ports and sent to the English markets or abroad in containers as required.

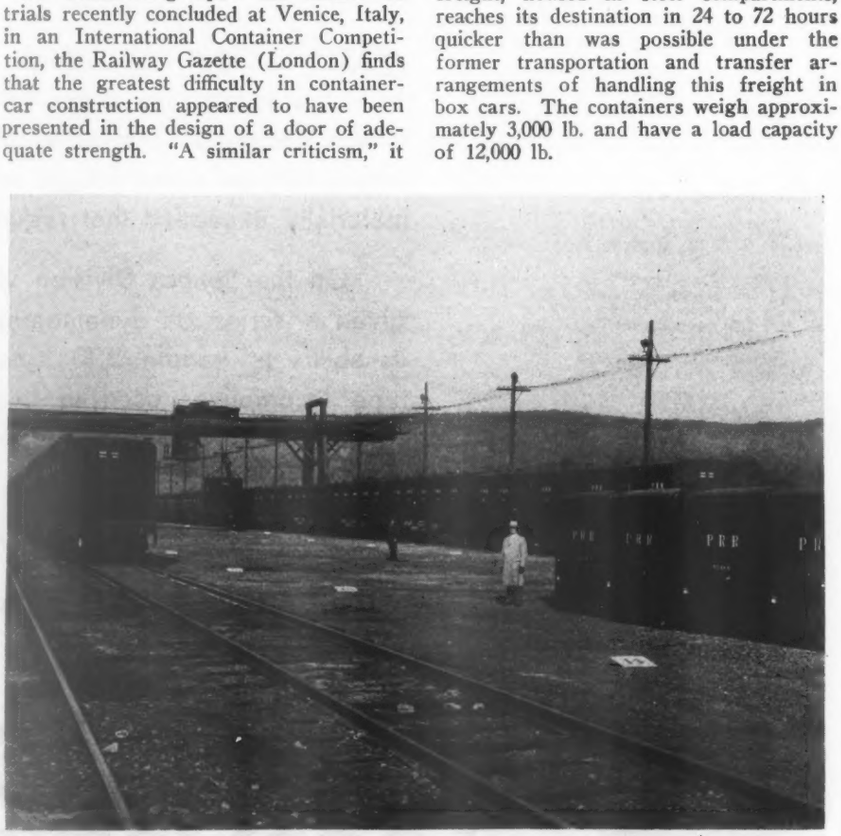
In commenting upon the results of trials recently concluded at Venice, Italy, in an International Container Competition, the Railway Gazette (London) finds that the greatest difficulty in container-car construction appeared to have been presented in the design of a door of adequate strength. "A similar criticism," it continues, "might be made of the locking devices; also of the methods of lashing the container to the truck—a feature which apparently had not received the same deep study as had the construction of the container itself.

"In reviewing the competition," the article concludes, "it is difficult at this stage to forecast its full value. It has undoubtedly served to give an international interest to the container movement. The research undertaken by the competitors in different countries must undoubtedly hasten the evolution of the ideal container. But, perhaps, more materially, the competition must serve to strengthen the link of co-ordination between rail and road which the adoption of container transport represents."

P. R. R. Container Transfer Station at Harrisburg, Pa.

THE GROWTH of container car business on the Pennsylvania has made necessary the construction at Harrisburg, Pa., an important transfer point, of a new container transfer station with track space for handling 75 container cars at once.

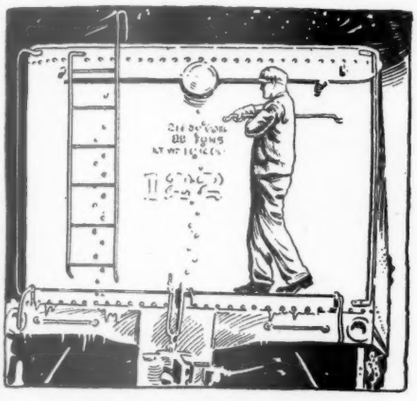
At that point solid container cars are made up for northern and western destinations from containers received from freight stations in Philadelphia, Camden, N. J., and Baltimore, Md. Containers are loaded without reference to destination and forwarded to Harrisburg, where they are classified and reloaded on cars for their respective destinations. Transfer operations are effected at the rate of one container each minute and a half and the freight, housed in steel compartments, reaches its destination in 24 to 72 hours quicker than was possible under the former transportation and transfer arrangements of handling this freight in box cars. The containers weigh approximately 3,000 lb. and have a load capacity of 12,000 lb.



Container transfer station of the Pennsylvania at Harrisburg, Pa.

Look Out for Winter Hazards

CIRCULAR No. 316, issued by the Committee on Education, A. R. A., to serve as a guide for railroad safety committees in January, is made up of notes on the hazards peculiar to the work of employees in very cold weather. The records of four years show that employees killed in train service accidents in January, February and March numbered 712, while in April, May and June, the total was 636. Looking only at two causes, the two most serious—*a* "being struck or run over by trains," and *b* "while getting on or off"—the difference is still greater; the train mileage being about the same, the reduction in fatal accidents under *a* was 28.3



Bad practice in winter

per cent as compared with the first (colder) quarter; under *b* it was 21 per cent.

One of the risks specially needed to be guarded against is that encountered by the fireman when he mounts the tender to take water. A colored poster has been issued illustrating this danger, a photographic copy of which, reduced, is here shown. A risky practice sometimes indulged in is shown in another illustration, an actual scene from life, where a brakeman walks across the rear end of the tender on the lift-lever rod.

Other hazards illustrated in the circular by pictures are: Too much snow heaped up around a switch stand; icicles neglected where hanging over the entrance to a building, and ice-covered ladders on the sides of freight cars.

Taking water in freezing weather

Domestic Orders Reported During December, 1931

Locomotives

Name of Company	Number Ordered	Type	Builder
Alaska Railroad	1	4-8-2	Baldwin Loco. Wks.
Delaware, Lackawanna & Western	10	4-8-4	American Locomotive Company
Total for month	11		

Freight Cars

Name of Company	Number Ordered	Type	Builder
Monsanto Chemical Works	11	Tank	American Car & Fdry. Co.
Total for month	11		

Strathcona Fellowships at Yale

APPLICATIONS are now being received for the five Strathcona Memorial Fellowships in Transportation, which are awarded annually at the Graduate School, Yale University. These Fellowships of $1,200 each, as the announcement points out, are offered "for advanced work in transportation, with special reference to the construction, equipment, and operation of railroads, and other engineering problems connected with the efficient transportation of passengers and freight, as well as the financial and legislative questions involved. Transportation by water, highways, or airways, and the appropriate apparatus involved, and also other general aspects of the broad field of transportation, embracing its legal and economic phases, will be included in the lists of subjects which the Fellows may select for investigation and study. The holder of a Fellowship must be a man who has obtained his first degree from an institution of high standing. The primary purpose of the Fellowship is to promote advanced work, especially research; but it is possible to combine such work with the attainment of an advanced degree. In making the award, preference is shown, in accordance with the will of Lord Strathcona, to such persons or to the sons of such persons as have been, for at least two years, connected in some manner with the railways of the Northwest."

Applications, which must be filed before March 1, 1932, should be addressed to the Dean of the Graduate School, Yale University, New Haven, Conn.

Wage Reductions

WHILE AWAITING the final negotiations of a meeting of the Railway Labor Executives' Association at Washington on January 14 to negotiate wage reductions and to consider other allied matters, several railroads have made agreements with their employees. The first acceptance of wage reductions by employees occurred on December 29, when 15,000 shopmen of the Southern Pacific, Pacific lines, accepted a 10 per cent cut. This agreement provides that, irrespective of what percentage reduction may be agreed upon with other organized employees, the shopmen's wages shall not be cut to exceed 10 per cent and that if other pay cuts are smaller, the shopmen's reduction shall be brought to a corresponding level, with adjustment retroactive to January 1. Likewise, if other organizations enter into agreements to become effective on a date subsequent to January 1, the effective date of the shopmen's lower pay shall be changed accordingly, with restoration of deducted amounts. During the negotiations leading to this agreement, the shopmen asked that no further wage reductions be made and that a minimum working week of four days be guaranteed. Following the agreement with its shopmen, the Southern Pacific notified the Brotherhood of Maintenance of Way Employees that the pay of its members will be cut 15 per cent, effective in 30 days.

Employees of the Southern Pacific lines in Texas and Louisiana, including train dispatchers, yardmasters, supervisory foremen in the mechanical department, clerical employees in the general offices, shop crafts, dining car employees and certain passenger train employees, agreed to a 10 per cent reduction in wages on January 2.

On January 4 shopmen on the Illinois Central agreed to a 10 per cent wage reduction, effective January 1.

Shopmen of the Denver & Rio Grande Western on December 30 accepted, voluntarily, a reduction of 10 per cent in wages to assist the road in keeping the shops in operation and in providing employment for the largest possible number of men. The reduction is a temporary arrangement and as soon as conditions improve, former wage scales will be restored.

Air-Conditioned Cars on the Santa Fe

THE ATCHISON, TOPEKA & SANTA FE is equipping 10 dining cars with the air circulating and cooling system which employs steam from the engine as the refrigerating energy and water as the sole refrigerating medium, thereby eliminating gaseous refrigeration. These cars are soon to be put in service on transcontinental trains.

This system is furnished by the Safety Car Heating & Lighting Company. It was developed by the Carrier Engineering Corporation and is made available through the co-ordinated efforts of the Safety Car Heating & Lighting Company and the Vapor Car Heating Company, Inc. These will be the first cars to be equipped with this type of air cooling system for operation on a railroad and will maintain a temperature not to exceed 80 deg. with a relative humidity of 50 per cent, when the outside temperature is 100 deg.

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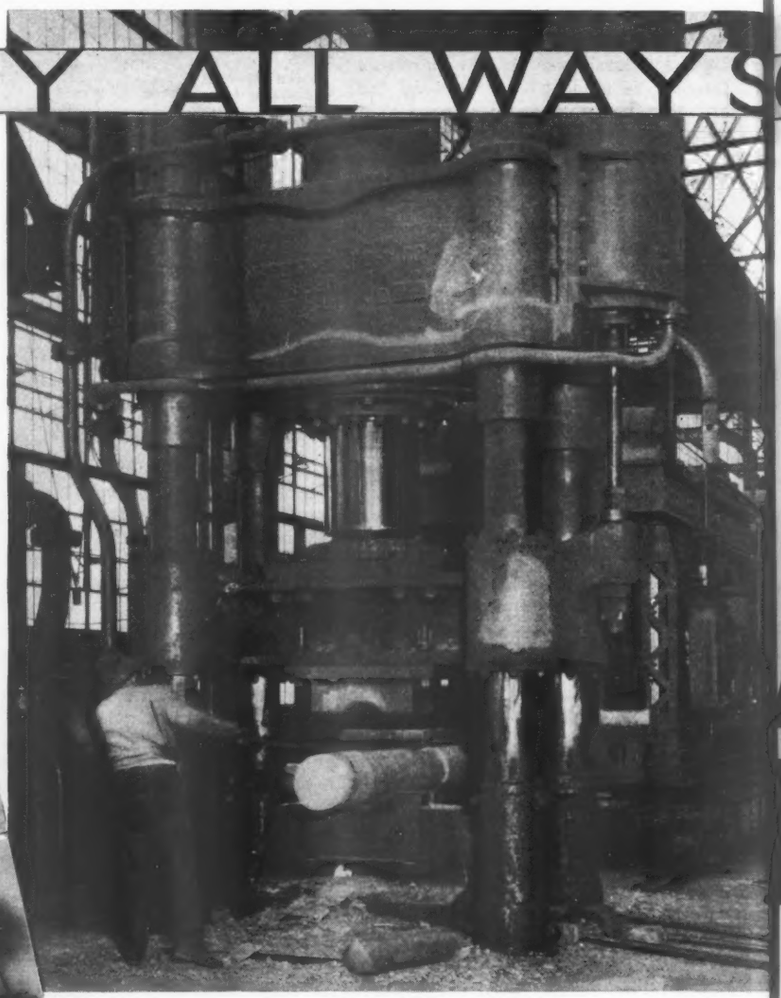
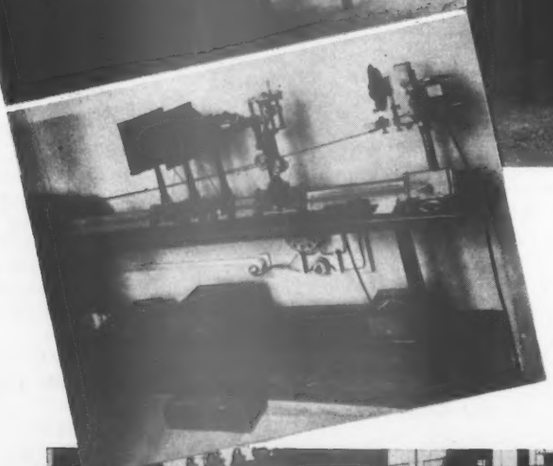
QUALITY ALL WAYS





Forgings of great strength, uniformity and toughness perform longest in hard service for the fewest maintenance dollars. For such low cost, dependable service specify—ALCO Forgings.

QUALITY ALWAYS

ALCO FORGINGS

ALCO Forgings insure maximum ton-miles for the fewest maintenance dollars—that means economy. Their great strength and durability give maximum insurance against the engine failures which jeopardize earning power and pile up maintenance expense—that means more economy plus safety.

Dependable locomotive performance is so important that there should be no compromise with quality in locomotive forgings. And there are no short cuts to high quality.

The manufacture of quality forgings involves a series of necessary scientific operations. Each must be carefully executed under technical control and properly correlated for best results.

ALCO quality forgings are made from billets which must pass rigid tests for chemical properties and physical soundness. High carbon steels are subjected to a tensile test and alloy steels to a full section macroscopic test. The billets are properly preheated before forging, using indicating and recording pyrometers to eliminate guesswork and the human element. The forgings are formed on presses and hammers of sufficient capacity to insure proper penetration well into the mass. The forgings are then heat-treated, again under pyrometer control, to insure the best in grain refinement and the highest ductility with the desired tensile strength.

Experience proves that these forgings stand up under the severe stresses of hard service.

It's much cheaper for a railroad to buy ALCO forgings than to equip, maintain and operate shops to manufacture them.

American Locomotive Company
30 Church Street New York N.Y.

Supply Trade Notes

W. H. WOODIN, president of the American Car & Foundry Company, New York, has been elected president also of the American Car & Foundry Motors Company, to succeed C. S. Sale, resigned.

J. F. O'CONNOR, who has been associated with W. H. Miner, Inc., for 27 years as consulting mechanical engineer, has retired. Mr. O'Connor will be the recipient of a life annuity under a trust established for his benefit.

WILLIAM GROVE, formerly with the Ingersoll Milling Machine Company, Rockford, Ill., has become associated with the sales engineering department of William Sellers & Co., Inc., Philadelphia, Pa., specializing on planer type milling machines and floor borers.

JOHN A. KLEINHUIZEN, formerly engineer with the Pullman Company, Chicago, has been appointed engineer for the Dayton-Roderwald Company, Dayton, Ohio, a subsidiary of the Dayton Rubber Manufacturing Company. Mr. Kleinhuizen will specialize in axle train lighting devices.

THE SHAW-PALMER-BAKEWELL COMPANY, 409 East Third street, Los Angeles, Cal., has been appointed exclusive sales representative in the Los Angeles district for the Hypressure Jenny, the spray-cleaning machine manufactured by the Homestead Valve Manufacturing Company.

THE PULLMAN CAR & MANUFACTURING CORP. has been incorporated under Delaware laws with an initial capitalization of $1,000,000, to succeed the Pullman Car & Manufacturing Corp., a subsidiary of Pullman, Inc., incorporated in Illinois on June 18, 1924, to acquire the entire property, business and assets of the manufacturing department of the Pullman Company.

PHILIP L. MAURY, vice-president of Valentine & Co., at New York, has resigned and has been elected president of the Arco Company, Cleveland, Ohio, S. D. Wise, president of the Arco Company since 1901 and S. D. Weil, vice-president having retired. Mr. Maury has had a long experience in the paint industry having been connected with the Sherwin-Williams Company, at Cleveland, as manager of general industrial railway and marine sales and then as vice-president and general sales manager of the Detroit Graphite Company, Detroit, Mich., until that company was merged with Valentine & Co., when he became vice-president of the last named company at New York.

JOHN H. TRENT has been appointed general manager of the Transportation and government department, Western and southwestern divisions, of the Johns-Manville Sales Corporation, New York. Mr. Trent's headquarters will be at St. Louis, Mo. He was born in Meade county, Ky., and was educated in the public schools of Paducah, Ky. In 1901 he entered the service of the Illinois Central and, after serving in the mechanical and stores departments at the Burnside shops, Chicago, became storekeeper at Water Valley, Miss., subsequently serving at Memphis, Tenn., and Paducah. Mr. Trent has been in the service of the Johns-Manville Sales Corporation for the past twenty-five years.

D. B. BULLARD, mechanical engineer; J. W. Bray, sales manager, and Col. L. S. Horner, a new member of the Bullard Company, Bridgeport, Conn., have been appointed vice-presidents in charge of engineering, sales and business promotion, respectively. E. C. Bullard retains the position of vice-president and general manager to which he was recently appointed, and E. P. Blanchard has been appointed sales manager. Colonel Horner

Col. L. S. Horner

was at one time president of the Niles-Bement-Pond Company. He is now also a director of the Niles-Bement-Pond Company, the Crocker Wheeler Electrical Manufacturing Company, the Acme Wire Company, the Burden Iron Company, and the Trucktor Corporation. He was a lieutenant-colonel in the United States Army Air Service during the war, and was later a director of the United States Chamber of Commerce and other national organizations. He is a member of the American Institute of Electrical Engineers, the Electrical Manufacturers' Club, the Ordnance Association, the New Haven Chamber of Commerce, the United States Chamber of Commerce, and numerous other clubs, including the Engineers Club, the Lotus Club of New York, and the Army and Navy Club of Washington.

J. FREDERIC WIESE, assistant to the general manager of sales of the Lukens Steel Company, Coatesville, Pa., has been appointed assistant to F. H. Gordon, vice-president in charge of sales. John J. Bleecker has been appointed manager of sales research and advertising for the Lukens Steel Company and its divisions, Lukenweld, Inc., and By-Products Steel Corporation, and Harry H. Peck, formerly with the Standard Steel Works Company at Burnham, Pa., has become manager of sales of Lukenweld, Inc., at Coatesville, succeeding Mr. Bleecker. Mr. Wiese, upon graduation from Swarthmore College in 1921, joined the staff of the Parkesburg Iron Company, Parkesburg, Pa., as mill representative, with headquarters at Chicago, covering the

J. Frederic Wiese

midwest, southwest and northwest. In this work his principal contact was with the railroads. He became assistant to general manager of sales of the Lukens Steel Company in 1926 and two years later was placed in charge of the sale of Lukens products to the railroads. In his capacity as assistant to Mr. Gordon, Mr. Wiese will continue his supervision of railroad sales.

R. L. SUHL has been appointed manager of the nickel sales department of the International Nickel Company, Inc., succeeding Frederick S. Jordan, deceased. Ransom Cooper, Jr., Walter C. Kerrigan, and Charles McKnight have been appointed assistants to Mr. Suhl. Mr. Suhl joined the original International Nickel Company on May 1, 1903, as laboratory assistant at the Bayonne (N. J.) refinery. He was appointed superintendent of electrolytic refining in 1908 and during the World War, as superintendent of the oxide division, had entire charge of the roasting and leaching of the ores. In 1920 he joined the headquarters staff of the company at New York as a development engineer, continuing as a member of the development and research department until 1928 when he became assistant sales manager in the Nickel department. Previous to 1929 Mr. Cooper was vice-president and sales manager of the American Mond Nickel Company. Mr. Kerrigan became associated with the International Nickel Company two years ago, having previously been general manager of the United States Nickel Company at New Brunswick, N. J. Mr. McKnight, since 1922, has been in charge of alloy-steel development for the International Nickel Company.

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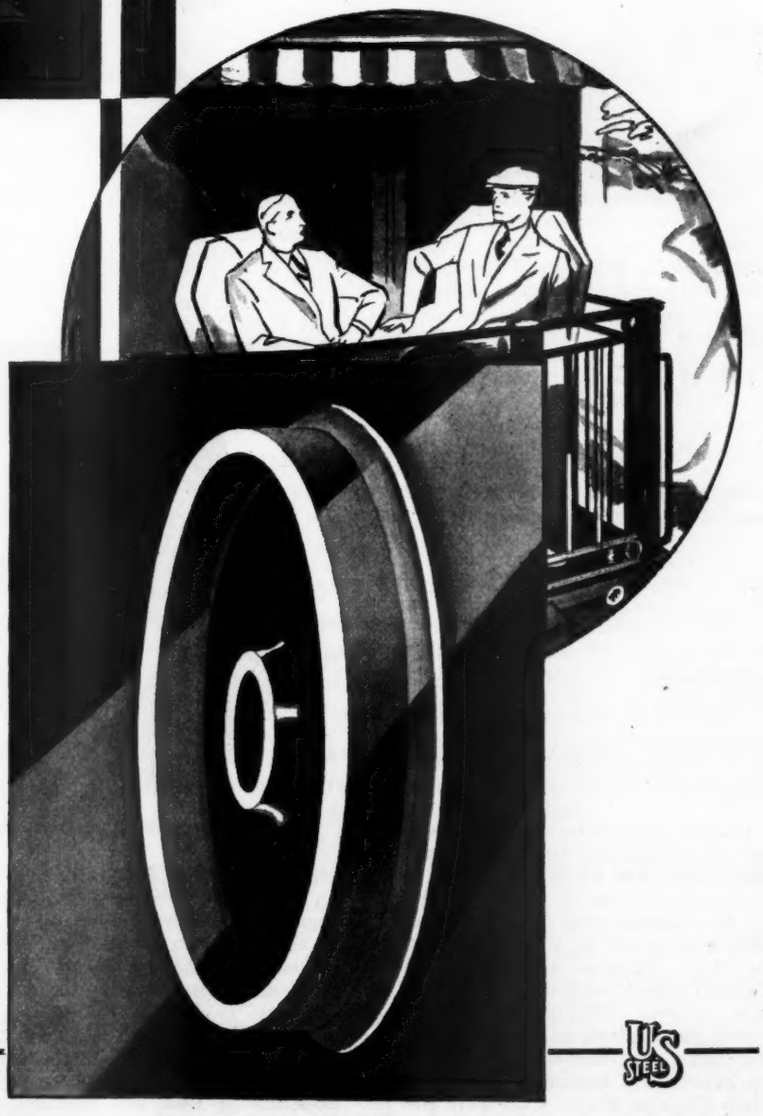
To those who *must* have QUALITY



THE decisions of railway officials in the matter of purchases of materials are directly reflected in passenger safety and comfort. Realizing this, officials of many prominent railroad systems settle their wheel question by specifying Carnegie Wrought Steel Wheels. Their faith is firmly substantiated by the safe and efficient service these wheels have always rendered.

To anticipate the constantly increasing demands of modern high-speed transportation, Carnegie Rim-Toughened Wrought Steel Wheels are now available for all classes of service. The special process of heat treatment adds materially to the service ordinarily expected of wrought steel wheels. Accurate machining insures perfect rotundity with a consequent increase in riding comfort. Carnegie Rim-Toughened Wheels are quality wheels for those who must have equipment preeminently reliable. Carnegie wheel engineers are at your service at all times.

U.S. STEEL

CARNEGIE WROUGHT STEEL WHEELS

Product of Carnegie Steel Company, Pittsburgh, Pa., Subsidiary of United States Steel Corporation 148

COL. R. H. MORSE, formerly vice-chairman of the board of Fairbanks, Morse & Co., Chicago, has been elected president and general manager to succeed W. S. Hovey, resigned.

CLARENCE H. HOWARD, former president of the Commonwealth Steel Company, and later chairman of the board of the General Steel Castings Corporation, died on December 6 at the Christian Science sanitarium, Boston, Mass., after a long illness of heart disease. Mr. Howard was born on February 22, 1863, at Centralia,

Clarence H. Howard

Ill., and was graduated from Manual Training School of Washington University in 1885. He learned the machinist trade and served as foreman and general foreman in the Missouri Pacific shops in 1886, then for two years was superintendent of the Missouri Car & Foundry Company and later assistant master mechanic on the Missouri Pacific. He then was manager of the Scarritt Car Seat Works and assistant general manager of the St. Charles (Mo.) Car Company. He was subsequently for eight years western manager and secretary of the Safety Car Heating & Lighting Company; then served as vice-president and general manager of the Shickle, Harrison & Howard Iron Company and later as vice-president of the American Steel Foundries. He was president of the Commonwealth Steel Company, from 1904 until it was consolidated with the General Steel Castings Corporation in August, 1929, and then served as chairman of the board of the latter company until his resignation in May, 1931.

HAROLD BROOKS GARDNER, eastern manager, Westinghouse Air Brake Company, New York, died on January 2, of pneumonia, at his home at New Rochelle, N. Y. Mr. Gardner was born on March 5, 1895, at Altamont, N. Y. He was a graduate of the Altamont high school and of Union College, receiving his degree of A.B. in 1916. On leaving college he joined the Locomotive Stoker Company, Pittsburgh, Pa., and in 1917 enlisted in the Regiment of Engineers of the Thirty-Sixth Division of the A.E.F. He was in the service two years, during one of which he was in action at Verdun. After his discharge from service, he returned to the Locomotive Stoker Company and continued with that organization until 1923, when he joined the New York office of the Westinghouse Air Brake Company. In 1926 he went to Chicago as vice-president of the Westinghouse

Harold Brooks Gardner

Friction Draft Gear Company. One year later he was appointed eastern manager of the Westinghouse Air Brake Company, with headquarters at New York. Mr. Gardner was a member of a number of clubs, including the Engineers' Club and the New York Railroad Club.

FREDERICK S. JORDAN, sales manager of the nickel department of The International Nickel Company, Inc., New York, and for the past thirty years connected with the nickel industry, died at his home in New York on December 16 from cere-

Frederick S. Jordan

bral hemorrhage. Mr. Jordan was born on August 28, 1869, at Berea, Ohio. He began his business career at the age of 18 as a secretary in the Cleveland office of the Cleveland, Cincinnati, Chicago & St. Louis. A year later he became private secretary to H. P. McIntosh of The Canadian Copper Company, and when that company was merged into the organization of the original International Nickel Company in 1902, Mr. Jordan went to New York as sales executive, a position which he held during the development of the company. At the time of his death he was sales manager of its nickel department.

Personal Mention

General

R. P. BLAKE, master mechanic of the Northern Pacific at Tacoma, Wash., has been appointed general mechanical inspector, with headquarters at St. Paul, Minn.

M. A. DALY, master mechanic of the Northern Pacific at Pasco, Wash., has been appointed fuel supervisor of lines west of Paradise, Mont.

F. J. REGAN, road foreman of engines of the Northern Pacific at Auburn, Wash., has been appointed assistant fuel supervisor of the lines east of Paradise, Mont., with headquarters at Livingston, Mont.

M. F. BROWN, general fuel supervisor of the Northern Pacific at St. Paul, Minn., has been appointed fuel supervisor of the lines east of Paradise, Mont., with headquarters at St. Paul. The position of general fuel supervisor has been abolished.

Master Mechanics and Road Foremen

D. W. DAVIS has been appointed assistant master mechanic of the Lehigh division of the Lehigh Valley with headquarters at Ashmore, Pa.

M. JEFFERSON has been appointed master mechanic of the Lehigh division of the Lehigh Valley, with headquarters at Easton, Pa., succeeding C. F. Helme.

L. J. GALLAGHER, master mechanic of the Fargo division of the Northern Pacific, has transferred his headquarters from Dilworth, Minn., to Jamestown, N. D.

T. M. HAWKINS, assistant master mechanic, purchasing agent and storekeeper of the Quebec Central, has been appointed master mechanic, with headquarters as before as Sherbrooke, Que., succeeding G. M. Robins, retired.

J. A. MARSHALL, master mechanic of the Seattle division of the Northern Pacific at Seattle, Wash., has been transferred to the Tacoma division, which now includes the Seattle division, with headquarters at Tacoma, Wash.

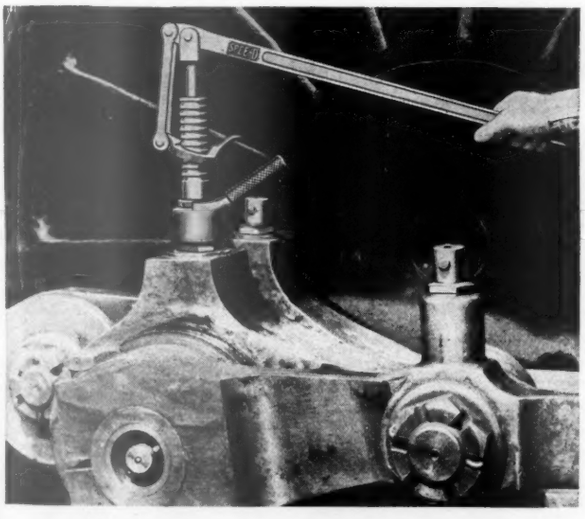
E. H. CARLSON, master mechanic of the Montana division of the Northern Pacific at Livingston, Mont., has been transferred to the Rocky Mountain division, with headquarters at Missoula, Mont. The Montana division has been abolished.

W. E. DUNKERLY, master mechanic of the Dakota division of the Northern Pacific, with headquarters at Jamestown, N. D., has been appointed master mechanic of the Pasco division, with headquarters at Pasco, Wash. The Dakota division has been abolished.

C. F. HELME, master mechanic of the Lehigh division of the Lehigh Valley at Easton, Pa., has been appointed superin-

(Continued on next left-hand page)

Why Use Your Appropriations *to* Ballast *the* Tracks?



The biggest savings effected by the "SPEE-D" method of rod cup lubrication are, of course, in engine preparation costs. One railroad is saving over $100.00 per locomotive per year.

Trade Mark Registered

THE annual cost of those grease plugs which you manufacture or purchase to replace those lost along the right of way would pay for the installation of "SPEE-D" equipment on many locomotives.

Once applied "SPEE-D" Filler Necks become part of the rods—loss is impossible. Removals are rarely necessary—the threads are protected against wear. No longer will it be necessary to re-tap worn cups—turn up bushings for over-sized holes or carry several sizes of plugs in stock.

Figure up your annual costs in rod and pin maintenance and use the figures to help you hammer home your requisitions this year for "SPEE-D" equipment.

RELIANCE MACHINE & STAMPING WORKS, Inc.

NEW ORLEANS, LA.

Agents and Representatives

H. C. MANCHESTER, 3712 Grand Central Terminal, New York City
Consolidated Equipment Company, Montreal
Mumford Medland, Ltd., Winnipeg
International Railway Supply Company, 30 Church St., New York City
A. L. Dixon, 325 W. Ohio Street, Chicago, Ill.

Saves Time, Labor, Grease and Grease Plugs

tendent of Sayre shops, with jurisdiction over Sayre engine terminal, assuming also the duties of master mechanic of the Wyoming division. Mr. Helme's new headquarters are at Sayre, Pa.

Car Department

N. J. BRICHER, general foreman at the Aurora (Ill.) shops of the Chicago, Burlington & Quincy, has been appointed acting general car foreman at Chicago, to relieve H. H. Harvey, who has been granted an extended leave of absence.

Purchasing and Stores

T. FAWCETT has been appointed general storekeeper of the Canadian Pacific System, with headquarters at Montreal, Que.

A. A. GOODCHILD, general storekeeper, eastern lines, of the Canadian Pacific, retired on January 1, after serving that company for the past 44 years.

HENRY HANSEN has been appointed assistant purchasing agent of the Northern Pacific, at St. Paul, Minn., succeeding Leonard Crassweller, retired.

J. G. STUART, general storekeeper of the Chicago, Burlington & Quincy, at Chicago, has been promoted to the position of assistant purchasing agent to succeed P. Hunter.

G. H. MULVAGH, chief clerk in the operating department of the Quebec Central, has been promoted to purchasing agent and storekeeper, with headquarters as before at Sherbrooke, Que.

A. S. MACDONALD, division storekeeper of the Canadian Pacific, has been promoted to the position of assistant general storekeeper of the Western lines, with headquarters as before at Winnipeg, Man.

P. HUNTER, assistant purchasing agent of the Chicago, Burlington & Quincy, has been promoted to the position of purchasing agent, with headquarters as before at Chicago, to succeed E. F. Hasbrook, deceased.

R. D. LONG, assistant general storekeeper of the Chicago, Burlington & Quincy, has been promoted to the position of general storekeeper, to succeed J. G. Stuart, and the position of assistant general storekeeper has been discontinued.

C. E. RESLER, acting purchasing agent of the Minnesota & International (a subsidiary of the Northern Pacific), with headquarters at St. Paul, Minn., has been appointed assistant purchasing agent of the Northern Pacific, to succeed H. Hansen.

Obituary

J. F. DEEMS, who resigned as general superintendent of motive power, rolling stock apd machinery of the New York Central Lines in 1911, and who at one time was general superintendent of the Schenectady works of the American Locomotive Company, died on November 24, at Burlington, Iowa.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

"MODERN FIRE FIGHTING EQUIPMENT."—This is the title of catalog 29 issued by the American-LaFrance & Foamite Corporation, Elmira, N. Y.

STAINLESS STEEL.—Free-cutting stainless steel, known as Enduro-FC, is described in an eight-page booklet issued by the Republic Steel Corporation, Massilon, Ohio. Enduro-FC is for use in the manufacture of parts which require turning, boring, drill, threading, grinding and polishing operations. It is available in the form of billets, bars, rods and wire.

AUTOMATIC CYLINDER COCKS AND DRAIN VALVES.—The design and function of George automatic cylinder cocks, drain valves and drain and relief valves for railroad, industrial and marine use are described in Catalog 500 issued by the George Manufacturing Company, Philadelphia, Pa.

INDICATING, RECORDING AND TEMPERATURE CONTROLLING INSTRUMENTS.—The C. J. Tagliabue Manufacturing Company, Park and Nostrand avenues, Brooklyn, N. Y., presents in its general catalog No. 1000 the complete line of Tag controllers, recorders, dials, thermometers, hydrometers, oil-testing instruments and moisture meters. The many groups of instruments have been appropriately classified and general applications described and listed.

WELDING AND CUTTING.—The Bastian-Blessing Company, 240 E. Ontario street, Chicago, makers of Rego gas-welding and cutting equipment, has just issued a new catalog, No. 57, in pocket size, with 40 pages indexed for ready reference. This catalog lists specifications and prices of all types of welding and cutting torches, regulators, gas economizers, acetylene generators and the various accessories, fully describing each piece of equipment and listing its uses. Many helpful hints are included. The chapters on "How to Make Up a Special Outfit," "How to Chose a Torch," and "Regulators Make the Outfit," are of especial interest and value to those concerned with gas welding or cutting.

VANADIUM STEELS.—Specifications 3B to 9B, inclusive, covering High Test Carbon Vanadium Cast-Steel for Locomotives and Other Castings, Silicon Vanadium Steel Bars for Railway Springs, Helical Springs of Silicon Vanadium Steel for Railways, Chrome Vanadium Steel Bars for Railway Springs, Elliptic Springs of Chrome Vanadium Steel for Railways, Chrome Vanadium Steel Bars for Automobile Springs, and Elliptical Steel Springs for Automobiles, respectively, have been revised and re-issued by the Vanadium Corporation of America, 120 Broadway, New York.

VIM SHORT-CENTER DRIVES.—The engineering research staff of E. F. Houghton & Co., Philadelphia, Pa., has prepared a 148-page treatise on short center drives using VIM special mineral tanned leather belting. The book contains charts, tables and engineering data on standard VIM efficiency drives ranging from 5 to 100 hp. It was originally published for use by Houghton's technical field men to assist them in discussing and working out transmission problems with engineers and will, therefore, be delivered only by a Houghton distributor to executives and engineers directly interested in transmission who will send in their requests on the letterhead of the concern or individual.

"FURNACE MALLEABLE" FITTINGS.—Specifications and drawings of Flagg "Furnace Malleable" 300 WSP fittings and unions, made from "refined" higher strength malleable iron especially adapted for railroad work, are shown in the 10-page catalog issued by Stanley G. Flagg & Co., Inc., 1421 Chestnut street, Philadelphia, Pa. The fittings are designed for steam, water or air up to working pressures of 300 lb. per sq. in. At regular intervals samples are subjected to hydrostatic pressures from 2,000 to 3,000 lb. per sq. in. The threads on the ends of pipe to be used with these fittings should be cut twice the pitch, or two threads, longer than is called for with standard fittings.

LOCOMOTVE CHART.—An interesting chart produced for the South African Railways by The Locomotive Publishing Company, Ltd., 3, Amen Corner, London, E. C. 4, diagrammatically shows the construction of a 4-8-2, Class 15CA, two cylinder locomotive having a boiler pressure of 200 lb. and a tractive force of 38,980 lb. The four illustrations on the diagram show the cab, front-end and underframe arrangements, and side elevation. The various details and devices on the locomotive are numbered, the names for each part being given in a correspondingly numbered list at the bottom of the chart. Complete or co-ordinated sections of the locomotive are shown in colors.

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Photo by M. Kettel, Geneva.

Interior view of the "Diner" recently placed in service for employees of the Electric Street Railways Company, Geneva, Switzerland — Non-alcoholic beverages only are sold